SEPTEMBER 1957

Power Engineering

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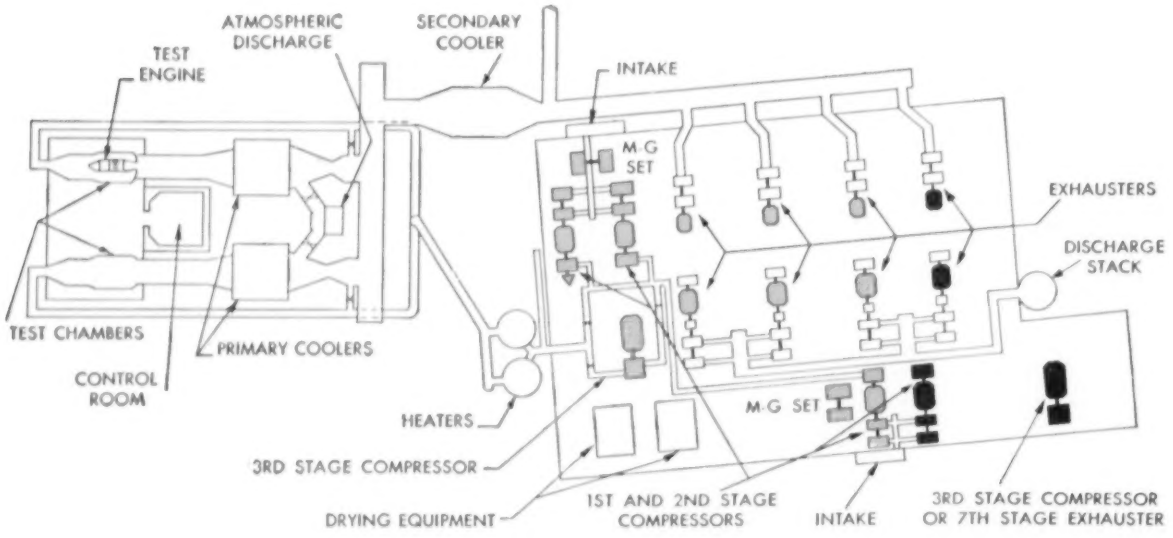
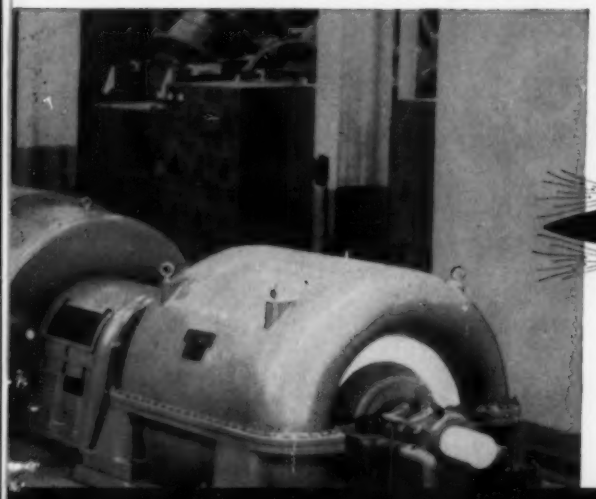
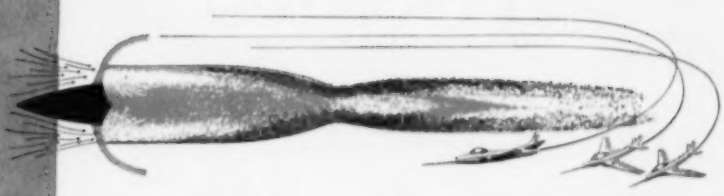
Each line of Elliott combustion air compressors (two are shown above) involves three casings. There are two first-stage casings with a total atmospheric inlet capacity of 106,000 cfm, discharging at 29.6 psia to the inlet of the second stage, which discharges at 60 psia. Unit at left shows, in the foreground, an Elliott radial in-flow expander. Behind the expander is the second-stage compressor, then the 16,500-hp, 3600-rpm synchronous motor, and beyond that are the two first-stage casings. In the background is the Elliott motor-generator set, a 5000-hp, 900-rpm wound-rotor induction motor driving a 4650-kva, 720-rpm alternator used for starting the synchronous motors.



In this layout of Propulsion Systems Laboratory, Elliott equipment already installed is indicated in orange. Elliott equipment on order and to be installed in the near future is indicated in solid black.





ELLIOTT COMPRESSORS AND MOTORS speed the nation's research at NACA's Lewis Flight Propulsion Laboratory

TO ACCELERATE important aircraft propulsion research, the National Advisory Committee for Aeronautics constructed the Lewis Flight Propulsion Laboratory in Cleveland. Testing facilities in the Propulsion Systems Laboratory at Lewis simulate jet engine speeds up to Mach 3 (three times the speed of sound at any given altitude) and altitudes above 60,000 ft.

To help create a wide range of in-flight conditions, important Elliott compressor and electric equipment has been installed. This includes Elliott combustion air compressors, and large 3600-rpm synchronous motors. In fact, to date the horsepower of Elliott motors installed and on order totals over 218,000, and the capacity of Elliott centrifugal compressors, over 359,000 cfm.

For information on how Elliott quality products can help you, call the nearby Elliott District Office, or write Elliott Company, Jeannette, Pa.

One of a line of three Elliott 10,000-hp, 3600-rpm synchronous motors which drive the second- and third-stage exhausters.

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS
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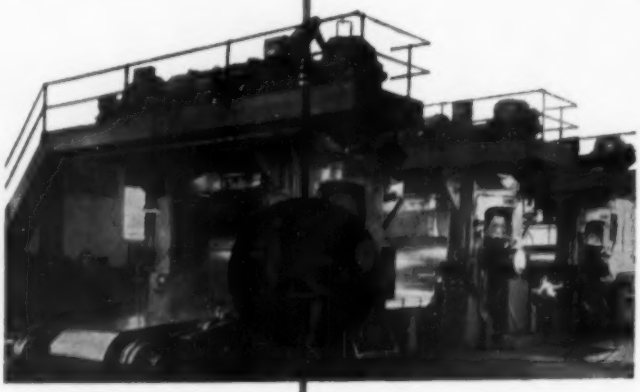
A small plug-in control box and resistance temperature detectors comprise the entire multi-point thermometer system. There is no scanning mechanism to delay the warning signal, few moving parts, no electronic tubes, and no costly circuitry. One **simplified** system eliminates the inaccuracy, danger and expense of attendants checking bearing temperatures by hand.

Omniguard is in use in thousands of installations continuously improving plant operation and lowering maintenance costs for production personnel from coast to coast. Write today for complete technical information.



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INDUSTRIES
INSTRUMENT DIVISION
WEST ORANGE, N. J.

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NBP EPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

NEW TESTING LAB for certifying master mechanical and electrical measuring devices has been opened by IT&T in its Federal Telephone and Radio Co plant in Clifton, N. J. Said to be one of the best equipped privately-owned installations of its kind, the new IT&T Standards Laboratory is designed to supply a convenient service which supplements and extends that of the National Bureau of Standards. Said Dr. Allen V. Astin, director of the National Bureau of Standards:

"There has been a lack of commercial facilities which could adequately undertake the services needed in dimensional and electrical measurement. This laboratory should go a long way towards meeting that need."

TWO REACTORS A MONTH is the ambitious production program of Aerojet-General Nucleonics of San Ramon, Cal. This manufacturer is the developer of a reactor known as the AGN 201 type, a low power unit for training, medical and industrial uses. AGN 201 is said to be the only operating nuclear reactor judged by the AEC to be safe enough for installation in existing buildings in heavily populated areas. Aerojet has received construction permits for 17 more AGN 201 reactors, nine of which are committed domestically and one for shipment abroad. The company now has European representatives marketing its line of reactors in France, Belgium, Holland and Germany.

NEW LINE-UP AT YARWAY (Yarnall-Waring Co of Philadelphia) has Bernard G. Waring filling the new office of honorary chairman of the board; D. Robert Yarnall as chairman of the board. President of the company is Frank W. Miller, with Joseph Kildare named senior vice-president for sales. Vice-president for manufacturing is D. Robert Yarnall, Jr, and John A. Steer becomes vice-president, general products sales, R. S. Pollard is vice-president, distributor products sales. Mary S. Trimble has been named treasurer and secretary, and George L. Tyndall, assistant treasurer and assistant secretary.

CHARLES T. MAXWELL, JR. has joined the editorial staff of POWER ENGINEERING as associate editor, adding still another potent member to the already-powerful and expanding group of engineer-editors serving our 41,000 readers.

Charles T. Maxwell, Jr.

He was born in Iowa and was educated at California Institute of Technology and Iowa State College, from which he was graduated with a degree of B.S. in electrical engineering. His varied experience as engineer, maintenance superintendent and manager covers mechanical and electrical design, construction, operating, and maintenance of stationary, mobile and marine equipment in the steam, diesel, refrigeration and atomic fields. In addition to managing his own construction company, he has had experience with: Iowa Public Service Co; Iowa Power & Light Co; KNWL, Inc, construction contractors of Ft. Leonard Wood, Mo.; U. S. Rubber Co; U. S. Merchant Marine; Hartford Accident & Indemnity Co; V. J. Hagan Co; Strategic Air Command, USAF; and the Nuclear Power Division of The Martin Co.

He is a licensed marine engineer, certified for the operation of turbo-

electric vessels and a graduate of the U. S. Maritime Service T-E School at Chester, Pa. During the war he served with the U. S. Army Transportation Corps as a diesel engineer.

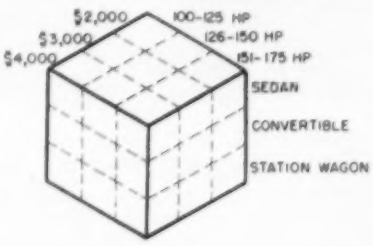
He holds a registered professional engineer's license in the state of Iowa and belongs to many professional and engineering societies including: the American Institute of Electrical Engineers; the American Society of Mechanical Engineers; the National Society of Professional Engineers; the American Institute of Plant Engineers; and the International Conference on Large Electrical Systems (CIGRE, France).

PORTUGAL, TOO, is going in for nuclear power. Start is a nuclear research reactor to be built for the Portuguese government by AMF Atomics, a division of American Machine & Foundry Co. The reactor will be the heart of a new nuclear research center being constructed near Lisbon. It is a one-megawatt, pool-type system using ordinary water as coolant, moderator and shield. Fuel will be uranium enriched to 20 per cent in the U-235 isotope, supplied under the Atoms for Peace program of the U. S. Atomic Energy Commission.

TOTAL THINKING — it's the latest. The fancy name for it is morphology, and its originator is Dr. Fritz Zwicky, widely known professor of astrophysics at Caltech, who now joins the scientific advisory board of Hycon Mfg Co.

The heart of morphology is the orderly presentation of possible solutions to a given problem. For example, your problem is the selection of a new car. You decide that the problem resolves itself into three separate areas of choice: body style, horsepower and price. You decide that you have three choices within each of these areas. This immediately presents 27 potential solutions to the new-car problem.

What you have really done is to project a three-dimensional morphological "box" (see figure) with three choices along each dimension. Construction of such a box is the second step in "total thinking." What it does is to present the researcher with an immediate large choice of alternative solutions, some of which represent unusual



combinations that otherwise would not have occurred to him.

But more than this, this box represents *all* possible solutions within the definition of the problem, allowing the researcher to turn his attention immediately to the job of eliminating obviously illogical solutions — without worrying whether some possible panacea has been accidentally neglected.

PROFESSOR WILLIAM E. REASER has left the faculty of engineering at Princeton University to accept appointment as assistant secretary of The American Society of Mechanical Engineers, it has been announced by William F. Ryan, ASME president. Responsibilities of this office encompass the relations with the membership in the sections throughout the United States, Mexico, Canada and Hawaii. An important phase of these activities is the work with students and recent graduates of the more than 140 accredited American colleges and universities.

JAMES N. LANDIS has been nominated to one of the highest professional offices in the country, president of The American Society of Mechanical Engineers. He will be installed in office, after a letter ballot of the membership, during the ASME annual meeting to be held in New York in December, to serve for a term of one year. Mr. Landis is vice president of Bechtel Corp, and is a past chairman of both the San Francisco Section of ASME and of its Metropolitan Section in New York, in addition to having held many other responsible Society offices the last 20 years.

He is the author of a number of technical publications and has been previously honored by ASME by election to the grade of Fellow.

BUYING MOOD struck four big utilities at about the same time, in contracts with Combustion Engineering, Inc, for boilers costing more than $25,000,000, which will supply steam for 1,270,000 kw of electric power. The four companies are Con-Ed of New York, Florida Power & Light, Pennsylvania Power & Light, and Florida Power Corp. Five boilers were included in these orders, the smallest for a 120,000-kw unit. In the four larger units, the companies were buying, for the first time, controlled circulation boilers — a special design for high-pressure, high-capacity installations.

FIGHT THE SMOG movement keeps briskly moving. Recent stimulators are Prof. A. J. Haagen-Smit of Caltech and Theodore A. Rich of GE, who presented papers on aspects of power plant air pollution at ASME's semi-annual meeting, in San Francisco. Both papers contained practical recommendations helpful to power plant engineers in calculating and controlling pollution from smokestack gases. Paper numbers are 57-SA-56 (T. A. Rich) and 57-S-59 (A. J. Haagen-Smit), at 50 cents each from ASME, 29 W 39th St, New York 18, N. Y.

WHAT IS EJC? ECPD? In the richly endowed world of engineering societies and special groups it's sometimes hard to keep straight on just who does what. The Engineers Joint Council, a federation of professional engineering societies, is helping to clear the air by issuing a concise pamphlet explaining its own structure and purpose in life. Called The Voice of the Engineer, this pamphlet is available from The Secretary, Engineers Joint Council, 29 W 39th St, New York 18, N. Y.

"CHECK BEARING ON CONDENSATE PUMP."

CHOOSE STOKER FIRING FOR ECONOMY AND SATISFACTION

Coal, Burned With a DETROIT STOKER Offers Many Advantages, Proven By Thousands of Installations

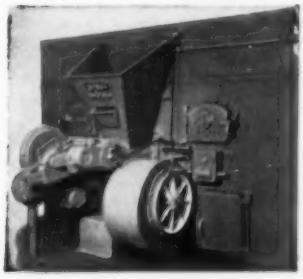
- Assured Fuel Supply
- Provides Steam At Lowest Cost
- Dependable—Noted For High Availability
- Maintenance Expense Low
- Requires Little Power For Operation

One of these Detroit Underfeed or Spreader Stokers will save you money—they are backed by over a half century of experience.

DETROIT ROTOSTOKER

Spreader stoker with OVER-THROW ROTORS that distribute the fuel uniformly in the furnace. Fine particles burned in suspension and coarse coal, burned on the grate. Four types of grates are available. RotoStokers burn successfully an extremely wide range of fuels without any special preparation. In combination with coal, RotoStokers also successfully burn wood and other refuse.

DETROIT UNISTOKER



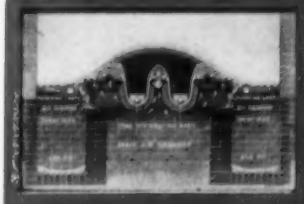
Plunger feed, side-cleaning stoker is available in various sizes for 125 to 250 horsepower boilers. Full-housed blower either motor or steam turbine driven, mounted at stoker front. Adjustable Feed provides for either manual or automatic coal feed control.

DETROIT ROTOSTOKER TYPE C-C

(Continuous Cleaning)

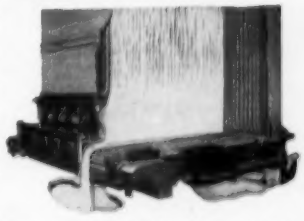
An important addition to the comprehensive "Detroit" line of spreader stokers. Readily applied to small and medium size steam generators approximately 5,000 to 75,000 pounds of steam per hour. The continuous cleaning grates automatically discharge the ash at the front for easy removal. No basement required.

DETROIT DOUBLE RETORT STOKER



A multiple retort stoker having two retorts, with the side-cleaning feature requiring no basement. Now available with Detroit Adjustable Feed Coal Feed Control. For medium sized boilers.

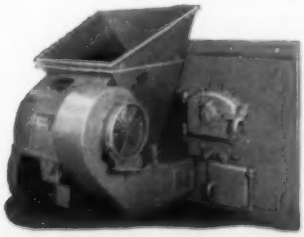
DETROIT ROTOGRATE STOKER



Spreader stoker with FORWARD MOVING GRATES for medium and large boilers up to approximately 400,000 pounds of steam per hour. Screenings or crushed run-of-mine coal used without grinding or pulverizing. Successfully burns a wide range of fuels, including lower grades of Bituminous Coal and Lignites . . . with preheated air if desired. Higher burning rates for longer periods with low excess air and without slagging or clinkering difficulties. Combustible in ash is unusually low.

DETROIT LOSTOKER

Has Detroit Adjustable Feed (Coal Feed Control).



A complete firing unit. Compact—single retort—mechanically driven—plunger feed—side-cleaning design. Many sizes and capacities for various types of boilers. Simple, accessible, dependable. A great coal saver.

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INVESTIGATE DETROIT STOKERS — IT'S THE ROAD TO ECONOMY AND SATISFACTION

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WHAT THEY TELL US

▶ **LET'S COIN** a new word: "AIRCON", suggests Reader R. M. Francis. He continues:

> How many times, in your daily walks of life, do you use the expression "Airconditioning"? And are you sometimes in doubt as to whether to write it Air-Conditioning, or Airconditioning? And isn't it a mouthful of words?
>
> In the complete gamut of all that pertains to this industry, and all that is written and printed about it, there must be thousands of wasted letters and much extra paper consumed each day. In the spirit of efficiency, brevity, and conservation of energy expended on tongue-twisting, I offer for your consideration, the coined word: AIRCON!
>
> Type it, write it, roll it around on your tongue. Looks and sounds pretty agreeable, doesn't it?
>
> I realize that I may be severely criticized by the authorities on correct speech; however, the expression AIRCON has been used for several years by a few engineers in the profession, and we do have a precedent to go on.

What do you POWER ENGINEERING readers think of it? We'd honestly like to have your opinions, for or against. Will you please do us a big favor and tell us how you like the suggestion? Thank you in advance.

▶ **THEY TELL US,** "Please send us 10 (or 20, or 40, or even 80) reprints of Ray Clapper's article on Repairing and Retubing of Tubular Heat Exchangers, June issue".

Already the demand from readers for reprints of this article have exceeded anything we have had for months. Because of our moving activities, we haven't yet had a chance to get an accurate count of these requests. But they were already 'way up in the hundreds before we moved, and every mail since then has been loaded with them.

Reprints of the article are now available. In case you don't have your June copy handy, the article was: Repair and Retubing of Tubular Heat Exchangers by Ray L. Clapper, POWER ENGINEERING, June 1957, pages 67–73. If you want a reprint of it, we'll send you one free as long as the supply holds out. Write the Editor, POWER ENGINEERING, 308 East James Street, Barrington, Illinois, or jot Heat Exchanger Tubing on one of the return post cards in the issue.

Incidentally, we'd like to point out that this is the sort of usable information that manufacturers' service organizations have, and can supply. We are always looking for it; in fact, we have more of the same type on other subjects coming from service engineers in other organizations manufacturing power equipment.

▶ **WE HOPE** you have taken to heart the many practical suggestions on How To Take Power Plant Photographs by Terry Mitchell in POWER ENGINEERING, June 1957 issue, page 70. Many readers have found it a very helpful article, and here is a typical comment from Reader C. E. Hassler:

> I have read with interest your article in POWER ENGINEERING entitled How To Take Power Plant Photographs. While reading the article I noted that the illustrations were all mostly of Frick equipment, but did not notice until later that you had written it. Do you recall the brochure which Frick Company published in 1928 entitled 75 Years of Progress? I well recall the day when you photographed me with what was then a small Frick unit, as shown on page 61 of that brochure.
>
> My work in Chicago has been with the YMCA of Metropolitan Chicago. The Chicago Association has 33 branches, of which 19 are sizable buildings. My relationship is with the engineers and executive secretaries of these buildings.

▶ **THIS IS TYPICAL** of the sort of letters we get constantly from POWER ENGINEERING readers.

Reader W. B. Rhodes asks:

> Will you kindly send me a copy of the Instructions on Filling Out Forms for Securing a Professional Engineers License in New York State as prepared by John D. Constance?
>
> This was suggested in the April 1953 issue of POWER ENGINEERING.

One swallow does not make a summer, we know. But we mention this merely as an indication of one way the magazine is used.

All editors of technical magazines know that many of their readers are always looking through back issues for data on a specific problem; and we have files full of correspondence like the above to prove that this is true of POWER ENGINEERING (as well as any other good technical magazine).

▶ **HARD HATS,** hard heads, hard logic or — hat tricks. Reader W. W. M. says the logic of our item on hard hats in Engineers' Preview, April 1957, page 3 — leaks! The logic, says he, doesn't hold water. He goes on:

> You prove that the hard hat is a better insulator than the peaked cap or the felt hat. Therefore, since the heat is generated from within the hat, 98.6 F body temperature, the hard hat will not dissipate the heat as well as the other hats you mention, even at ambient temperatures of 70–80 F the hands sweat.
>
> Many people drill a row of ¾-in. holes around the rim of the hard hats to get circulation.

But first! as the TV announcers say. We can't allow you to involve us in a logical matter. Moreover, *we* didn't make the hat tests; they were made by Standard Oil. If you want to get embroiled with *their* logic — w-e-e-l-l —

▶ **JOSEPH E. HALLORAN,** our New York District Manager, knowing of our interest in pumped storage, tells us that the New Jersey Power and Light Co is studying the possibility of building a pumped storage hydroelectric project on the Rockaway River at Longwood Valley, Jefferson Township. Although there are four other pumped storage projects now in operation in this country, this one in New Jersey, if it ever develops, would be the first one on the Eastern Seaboard.

(*Hey, Joe! How did you get into the editorial pages?*)

"Nice—but when we gonna get color?"

About the Cost of Living . . . with Steam Traps

WHEN YOU specify steam traps, what could possibly be more important than *the cost of living with them* — production cost . . . steam cost . . . downtime cost . . . repair cost.

No steam traps manufactured have ever provided greater equipment operating efficiency or lower trap maintenance cost than Armstrongs.

Consider the experiences of these companies:

"30% Greater Output from platen presses since installing Armstrong Traps" — rubber processor.

"$8000 Annual Fuel Saving since replacing 600 traps with Armstrong" — metal processor.

"30% Less Downtime for repairs with Armstrong Traps" — food processor.

"$25,000 Trap Maintenance Saving every year since installing 4000 Armstrong Traps" — major chemical plant.

You may well ask, "Can there really be so big a difference in steam trap performance?" The answer is: These are typical experiences of people who have compared Armstrong trap performance — not for a month or a year, but over periods of 2, 5 and even 10 years or more.

The Armstrong trap has certain fundamental advantages, including:

No Steam Loss — the valve is always water-sealed.

Large air-venting capacity — air is automatically discharged along with condensate.

Long-life parts — hardened chrome steel valve and seat — all other parts corrosion-resistant stainless. Absolutely nothing to stick, bind, clog or collapse. Not affected by ordinary dirt and scale.

Unconditionally guaranteed to satisfy. It takes an awfully good product to carry such a guarantee.

Steam traps can have such a big effect on plant operating efficiency, they are worth more than casual consideration. Let your Armstrong Factory Representative answer your questions. There is no obligation. Call him or write:

ARMSTRONG MACHINE WORKS
8109 Maple Street • Three Rivers, Mich.

Do you have "The Steam Trap Book"? —44 pages of useful data on trap sizing, calculation of condensate loads, installation and maintenance. Free on request.

ARMSTRONG STEAM TRAPS

For more data circle 504 on Post Card

rugged
. . . for

YARWAY UNIT TANDEM BLOW-OFF VALVE, combining Hard-Seat blowing Valve and Seatless sealing Valve in a common forged steel body. For pressures up to 1500 psi; hard-seat—hard-seat combination to 2500 psi. Welding connections shown. Flanged ends also available.

YARWAY

rugged blow-down service

YARWAY UNIT TANDEM BLOW-OFF VALVES

When boiler pressures are high you may not "blow-down" very often, but, man, when you do, you're glad those blow-off valves are rugged YARWAY Unit Tandems!

More than 80% of high pressure boiler plants are equipped with YARWAY *Blow-Off Valves,* and there's ample reason.

YARWAYS are strong, heavy-duty valves giving the important extra dependability needed for the severe combination of high pressures (hence high velocities), acid cleaning, and abrasion caused by precipitated solids.

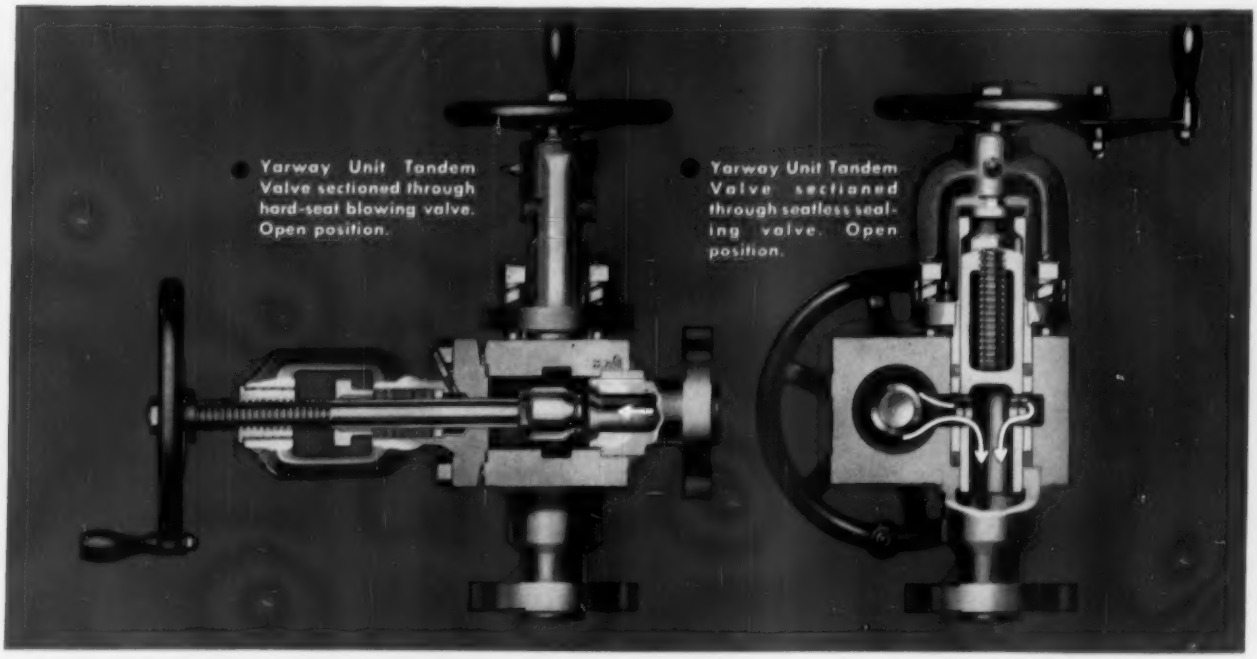
YARWAY Blow-Off Valves also are relied upon to keep boiler level within desirable limits during quick starts of high pressure boilers.

Specify YARWAYS—to protect *your* boilers. Write for Bulletin B-434.

YARNALL-WARING COMPANY

100 Mermaid Ave., Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES


Yarway Unit Tandem Valve sectioned through hard-seat blowing valve. Open position.
Yarway Unit Tandem Valve sectioned through seatless sealing valve. Open position.

— blow-off valves

For more data circle 505 on Post Card

1. Barrel type boiler feed pumps

2. Centrifugal compressors

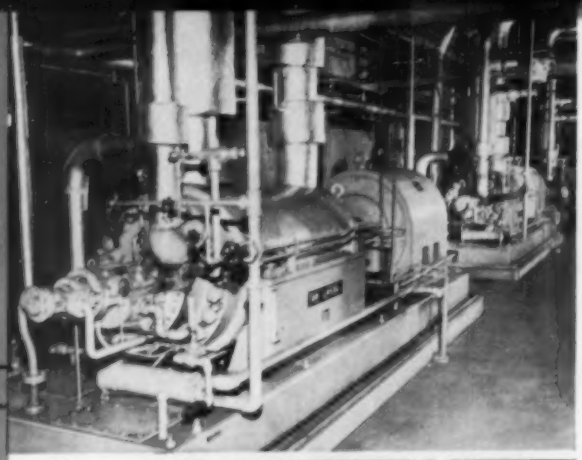
3. Centrifugal pumps for many services

4. De Laval IMO pumps for fuel oil transfer

5. De Laval IMO pumps for fuel oil burner service

6. Multi-stage turbine generators

1



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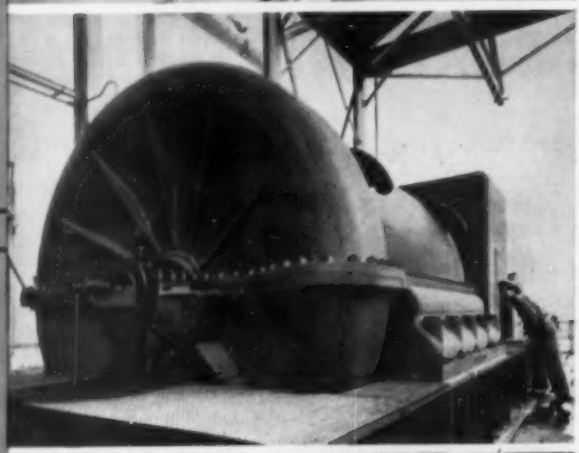

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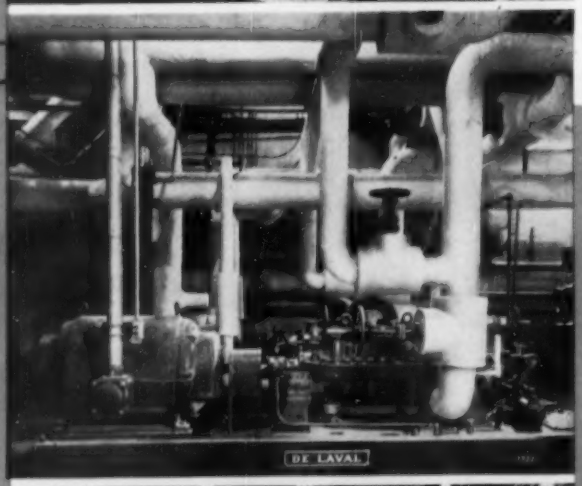

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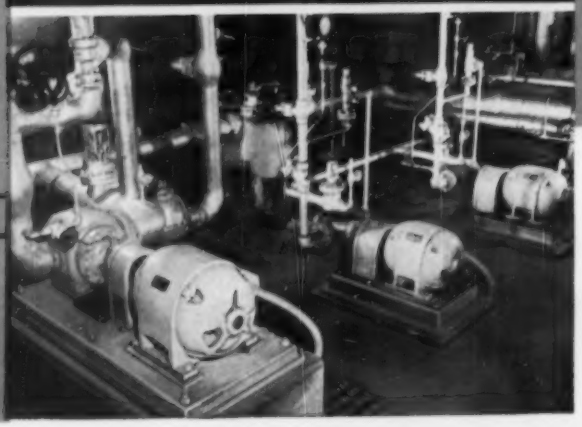

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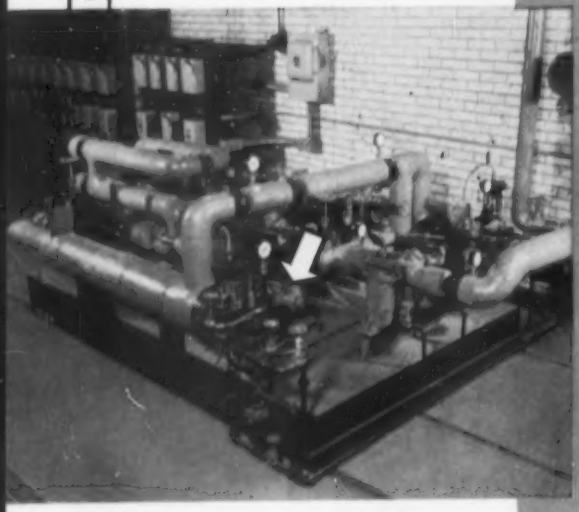
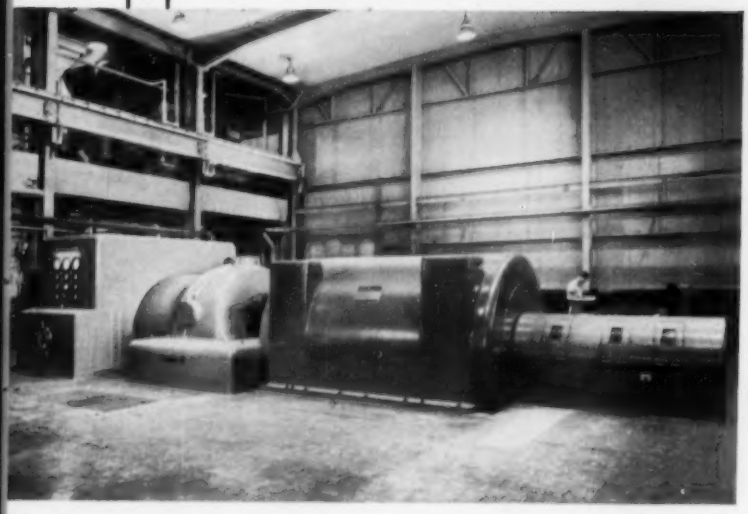


DE LAVAL

designs for dependability

6



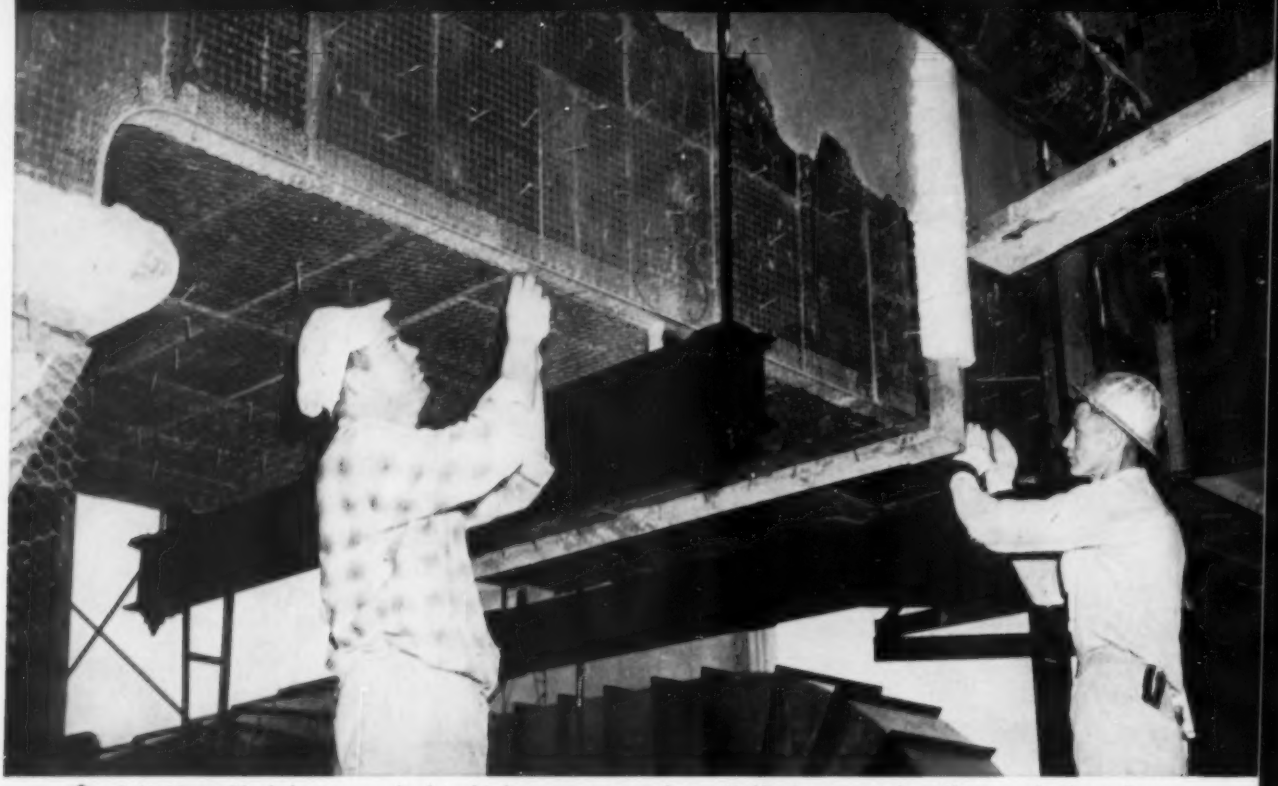
Machines
that *stay* in service
year in and year out
are the most economical.
Since 1901,
De Laval has supplied
quality-designed pumps,
compressors, and other
vital equipment for the
power industry.
Each unit is designed
for dependability and
built by master craftsmen.
As a result, the De Laval
name plate is your
assurance of reliability.
Literature is available
on all equipment
shown on these pages.

DE LAVAL Steam Turbine Company

816 *Nottingham Way, Trenton 2, New Jersey*

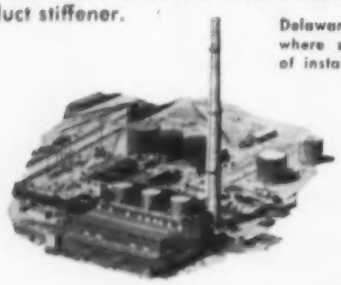
DL 191

3 Turbo Furnace Boilers in service in record time at DELAWARE CITY POWER STATION



B-M Mono-Block being applied to high temperature ducts. Half of wire studs still protrude from first layer of block to receive second layer. Wire mesh over block only on under side to facilitate application of B-H SUPER POWERHOUSE CEMENT. Half section of molded pipe covering bridges the duct stiffener.

Delaware City Power Station of the Delaware Power and Light Company where standardization on Baldwin-Hill Insulation and simplified methods of installation speeded the application on three 500,000 lb per hr boilers.



For Dependable Temperature Control

BALDWIN-HILL

Complete Line of Industrial

aided by BALDWIN-HILL MONO-BLOCK® and SUPER POWERHOUSE® CEMENT

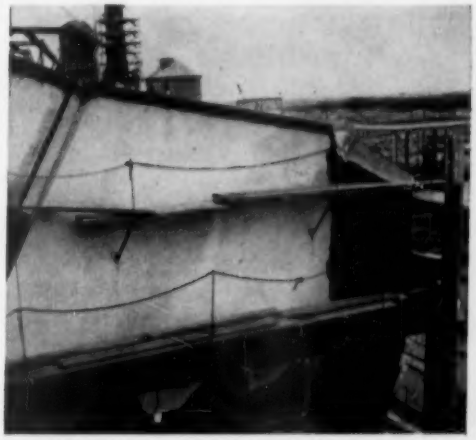
Careful planning along with standardization and simplification of both methods and materials by Riley engineers not only sped completion of the job but cut costs.

This was accomplished in part by the use of 1) one basic insulating block, B-H MONO-BLOCK, to cover all flat and large curved surfaces of boiler walls, accessory housings and ducts and 2) a one-course insulating-finishing cement, B-H SUPER POWERHOUSE CEMENT.

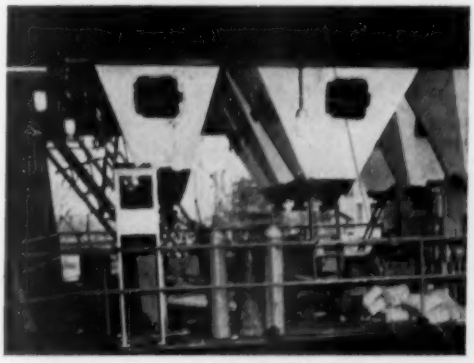
B-H MONO-BLOCK, made of spun mineral wool fibers felted into lightweight, rigid sheets, provides top thermal efficiency up to 1700° F. Easy to handle and cut to desired size and shape, it is quick to apply.

B-H SUPER POWERHOUSE CEMENT is a dry, fibrous material with a spun mineral wool base and a fast, hydraulic setting binder, which, when applied, combines good insulating value with a glazed, white finish. Its quick setting ability speeds work; allows subsequent operations to proceed without delay. After setting, it is not adversely affected by rain, sleet or snow.

Workmen applying B-H Mono-Block to casing in two layers, just above boiler skirt. Note how insulating block is easily cut to conform to bend in casing.



B-H Super Powerhouse Cement used as single coat insulating and finish coat over B-H Mono-Block on dust collector bin.



B-H Super Powerhouse insulating-finishing Cement covers B-H Mono-Block on dust collector hoppers.

See our catalog in Sweet's Plant Engineering File.

COMPANY

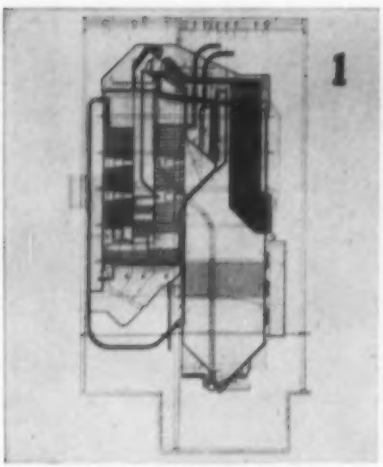
TRENTON, NEW JERSEY
209 Breunig Ave., Trenton 2, N.J.
Kalamazoo, Mich. . . . . Huntingdon, Ind. . . . . Temple, Tex.

Insulations

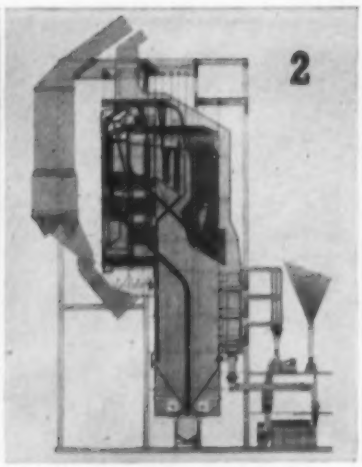
For detailed report on this installation, staple the keyed corner of this ad to your letterhead and mail

J454

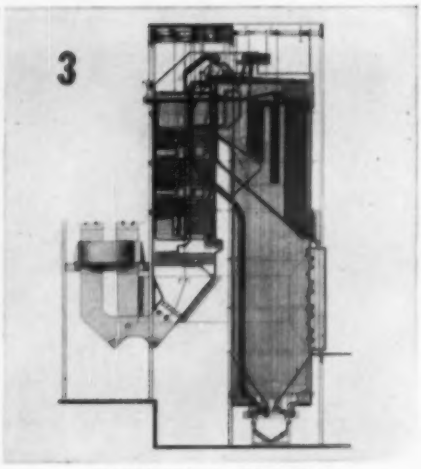
For more data circle 507 on Post Card



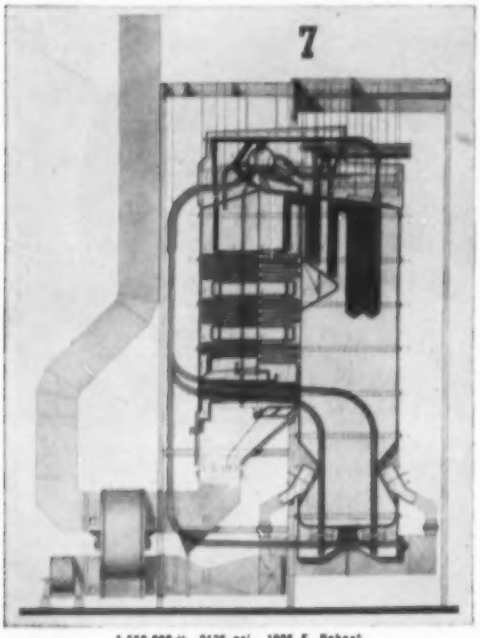
600,000 #, 1700 psi., 1000 F. Reheat



1,000,000 #, 2075 psi., 1005 F. Reheat



850,000 #, 1850 psi., 1000 F. Reheat

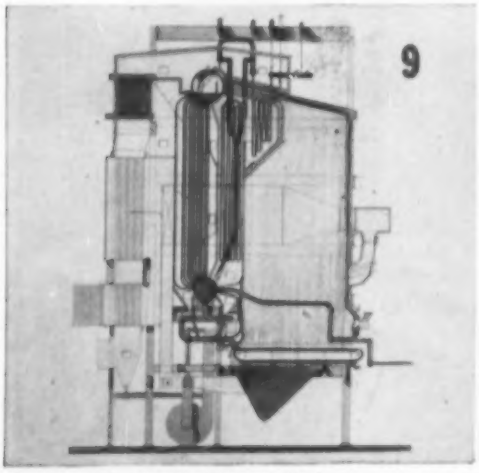


1,550,000 #, 2125 psi., 1005 F. Reheat
TURBO FURNACE

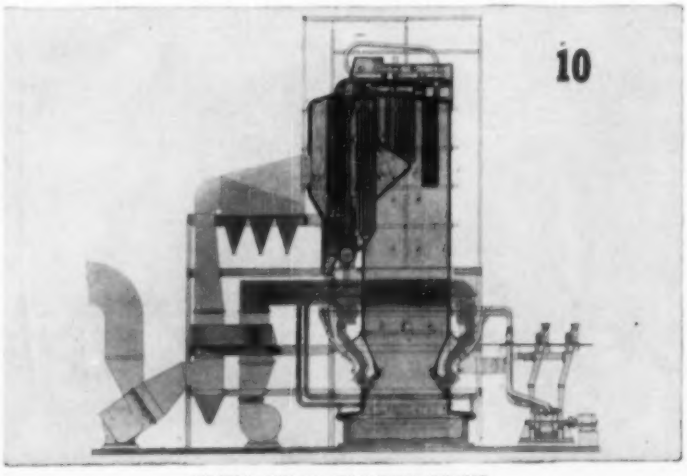
RILEY CENTRAL

that cover a wide range of

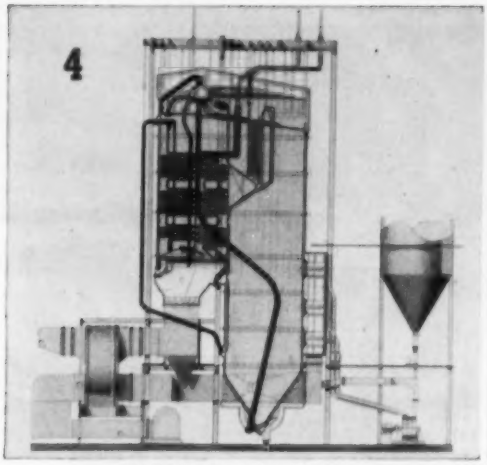
1. Florida Power Corporation – Oil
2. Public Service Company of Indiana, Inc. – 4 Units – Coal
3. Central Illinois Light Co. – Coal
4. Minnesota Power & Light Co. – 2 Units – Coal, Future Oil, Gas
5. Dallas Power & Light Co. – Gas, Oil, Future Lignite
6. Texas Electric Service Co. – Oil, Gas
7. Louisiana Power & Light Co. – Gas, Future Oil, Coal
8. Texas Electric Service Co. – Gas, Oil, Future Coal
9. Montana Dakota Utilities – Lignite
10. Delaware Power & Light Co. – 3 Units – Fluid Coke, Gas, Oil, Coal
11. Central Louisiana Electric Co. – 2 Units – Gas



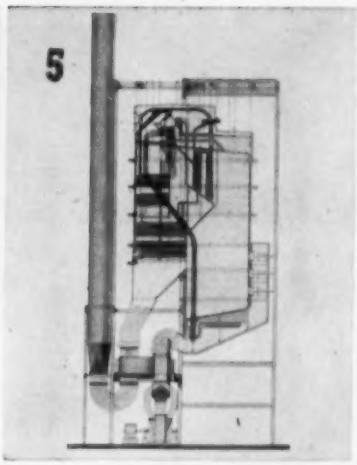
250,000 #, 1025 psi., 905 F.



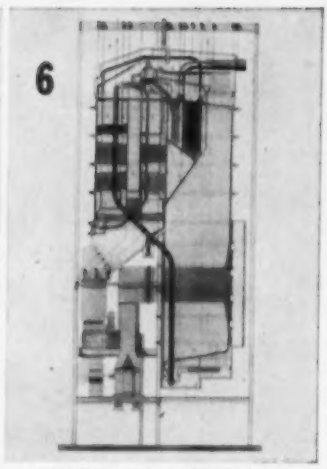
500,000 #, 1425 psi., 950 F. TURBO FURNACE



500,000#, 1725 psi., 1005 F. Reheat



1,050,000#, 1725 psi., 1005 F.



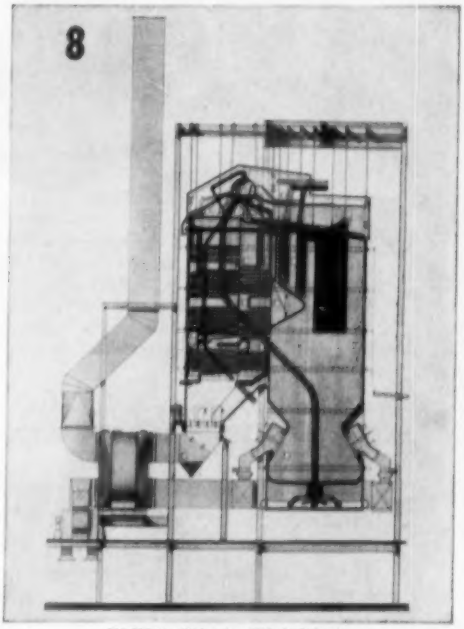
1,200,000#, 2125 psi., 1005 F. Reheat

STATION INSTALLATIONS

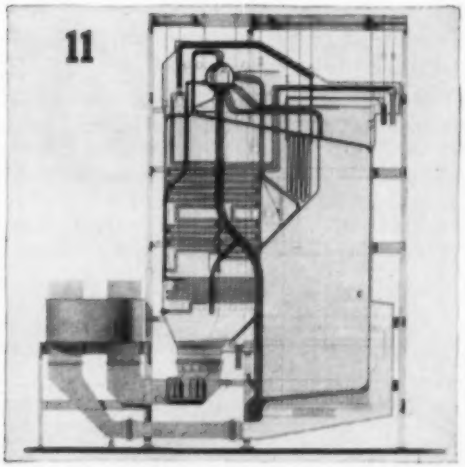
typical operating characteristics

These Riley Central Station Boiler designs are typical of many units that have been sold in recent years to a growing list of public utilities. This gratifying acceptance is a result of not only dependable and efficient operating characteristics, but because Riley, with its wide range of fuel burning products and the recent development of the TURBO FURNACE for multi-fuels, can offer the most economical solution to virtually any fuel burning situation.

Riley Boilers and Fuel Burning Equipment are *Designed, Manufactured, Erected and Serviced* under a single contract.



825,000#, 1750 psi., 1005 F. Reheat
TURBO FURNACE



350,000#, 1650 psi., 1005 F. Reheat

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY

Stoker Corporation

WORCESTER, MASSACHUSETTS

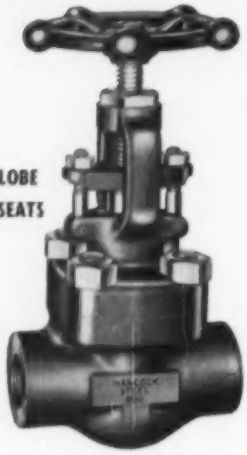
Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

For more data circle 508 on Post Card

NEW 600# STEEL

NEW

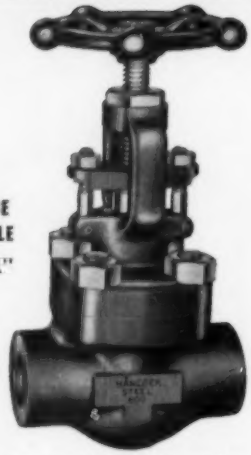
TYPE 5500 — 600# GLOBE
INTEGRAL HARD-FACED SEATS
"500 Brinell"
Stainless Steel Discs.



Especially suitable for high pressure steam and temperature services in power plants. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel A.S.T.M. A-105 Gr. II. **Alternate Body and Bonnet Materials:** 1¼% Chrome, ½% Moly Steel, A.S.T.M. A-182 Gr. F-11. **Connections:** Screwed and Socket Weld Ends. For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F.

NEW

TYPE 5520 — 600# GLOBE
TYPE 5530 — 600# ANGLE
RENEWABLE "300 BRINELL" STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel Plug Discs.



Ideal for processing plants and general industrial service. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel A.S.T.M. A-105 Gr. II. **Alternate Trims:** 18-8 Type 316 Stainless Steel; Monel. **Alternate Body and Bonnet Materials:** 5% Chrome, ½% Moly Steel, A.S.T.M. A-182 Gr. F-5; 18-8 Type 304 Stainless Steel A.S.T.M. A-182 Gr. F-304. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

These 600# bolted bonnet forged steel valves really make sense to every man who knows the economy of quality valves. Designed into them are plus values that substantially reduce profit-draining production shut-downs, maintenance problems and inventory costs. Built as companions to the widely-used Type 950 Hancock 800# Steel Gate Valves, they offer:

Thick, Rigid Body and Bonnet Flanges that can withstand more than ten times the rated pressure of the valve. The flanges butt — no bending, no distortion.

Re-usable Flexitallic Bonnet Gasket, in combination with the rigid body and bonnet flanges, prevents bonnet joint leakage. The gasket is a spiral-wound ribbon of stainless steel with asbestos filler and spring-like compressibility. It rests in a groove in the body flange — cannot blow out even if pressures exceed ten times the rating of the valve. *Hancock 600# Steel Valves are the first globe valves to use this important feature.*

Maximum Use of Stainless Steel. Even the stem, swing bolts, nuts, thread bushings and packing gland followers are stainless steel — your assurance of quality that saves throughout the long life of these valves.

The 5500 Line of Hancock 600# Steel Valves is available in Globe, Angle, "Flocontrol," Lift Check and Hi-Pressure Drop designs. Whatever your needs, you can buy these valves with complete confidence in their functional perfection. Like all other Hancock Valves, they are precision engineered and carefully manu-

HANCOCK VALVES

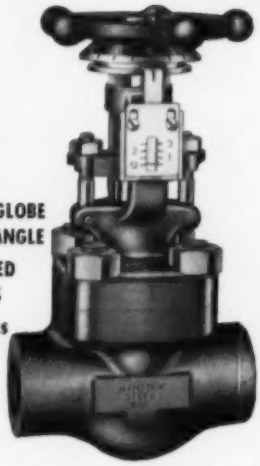
PHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR. His broad knowledge and experience can be of real value to you. Let him help you select the right Hancock Bronze and Steel Valves for all your service requirements.

H1-67

HANCOCK VALVES

NEW

"FLOCONTROL"
TYPE 5525 — 600# GLOBE
TYPE 5535 — 600# ANGLE
RENEWABLE HARD-FACED STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel V-Port Discs.



For general industrial service. Variable orifice, shut-off and index combined in a single valve. Any desired setting can be instantly duplicated. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

NEW

HI-PRESSURE DROP
TYPE 5505 — 600# ANGLE
INTEGRAL HARD-FACED SEATS
Stainless Steel Tube.

An orifice type valve, with shut-off and index in a single unit that permits the use of a smaller valve with a large capacity. Designed to withstand the terrific wrecking power of continuous blow-down. Also for use on feed-water, by-pass relief, in turbine washing processes, and where erosion is extremely severe. **Size:** 1". **Standard Materials:** Forged carbon steel. **Connections:** Screwed and Socket Weld Ends. For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. A.S.M.E. maximum boiler pressure 970 psi.

factured. You can be sure of long resistance to wire drawing, galling, steam cutting, erosion and corrosion — for leakproof tightness month after month. They surpass the toughest service demands of process and power piping systems in the most modern refineries, petrochemical, power and industrial plants. A high degree of standardization in all sizes simplifies both maintenance and inventory needs.

Let the durability, performance and economy of Hancock 600# Steel Valves save money for you. Whether you are adding facilities, building a new plant or setting up a revalving program, get all the reasons why these tough valves serve better and longer. Complete information is yours on request.

When Hancocks go in, valve costs go down

NEW

LIFT CHECK VALVE
TYPE 5540 — 600# GLOBE
RENEWABLE HARD-FACED STAINLESS STEEL SEATS
"500 Brinell" Stainless Steel Piston Discs.

For general industrial service. **Sizes:** ¼" thru 2". **Standard Materials:** Forged carbon steel. **Cap:** Bolted. **Connections:** Screwed, Socket Weld and Flanged Ends. **Screwed and Socket Weld Valves:** For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. **Flanged Valves:** For all pressures up to 600 psi at 850°F. O.W.G. — 1440 psi at 100°F.

A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, California.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Michigan.*

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

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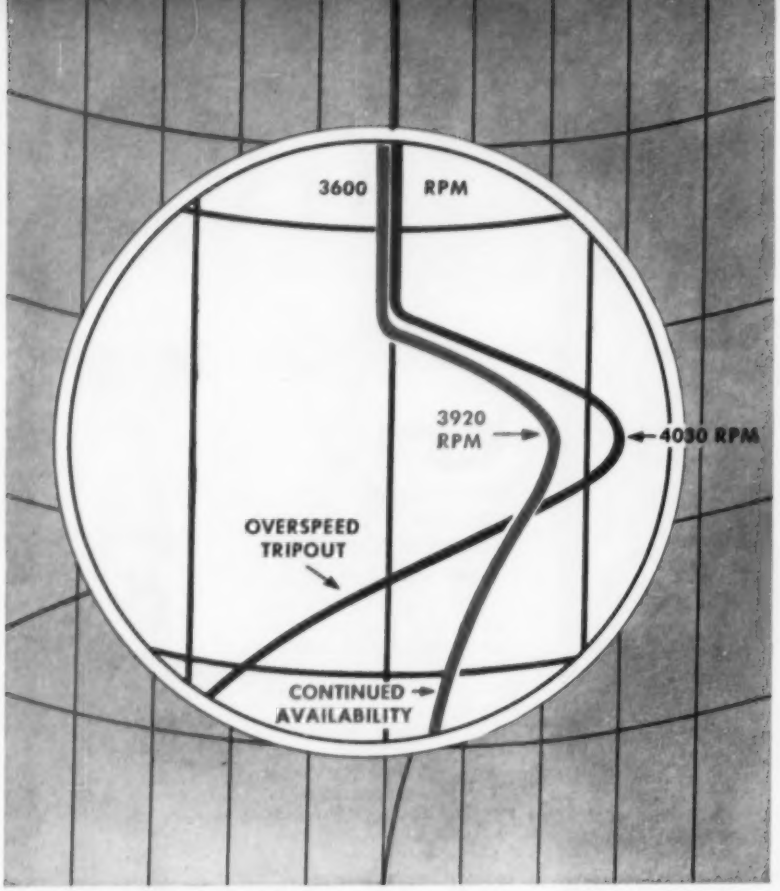
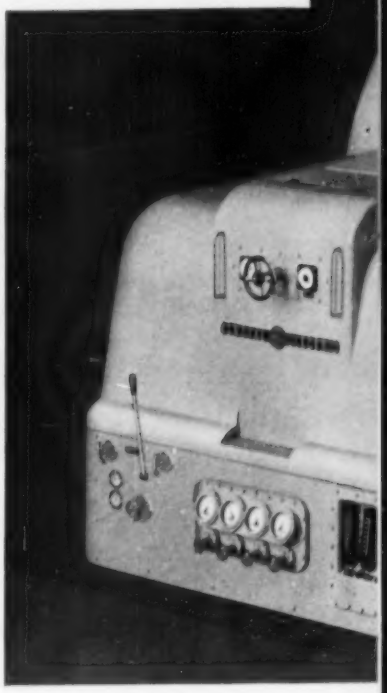
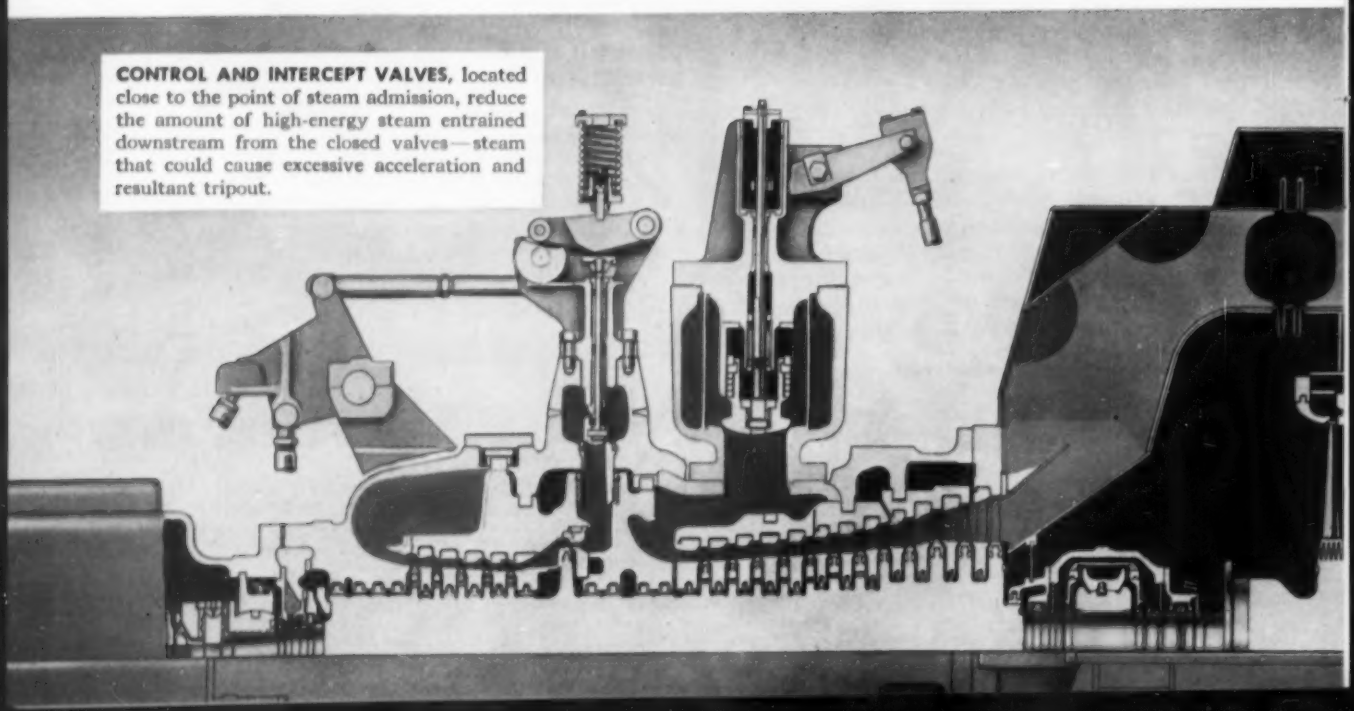


SENSITIVE GOVERNING SYSTEM helps avoid costly tripouts. The red curve, above, shows how a typical G-E reheat turbine stays below tripout speed by limiting speed to 3920 rpm during temporary system interruption. Without this split-second governing response, overspeed to 4030 rpm can result in costly shutdown.

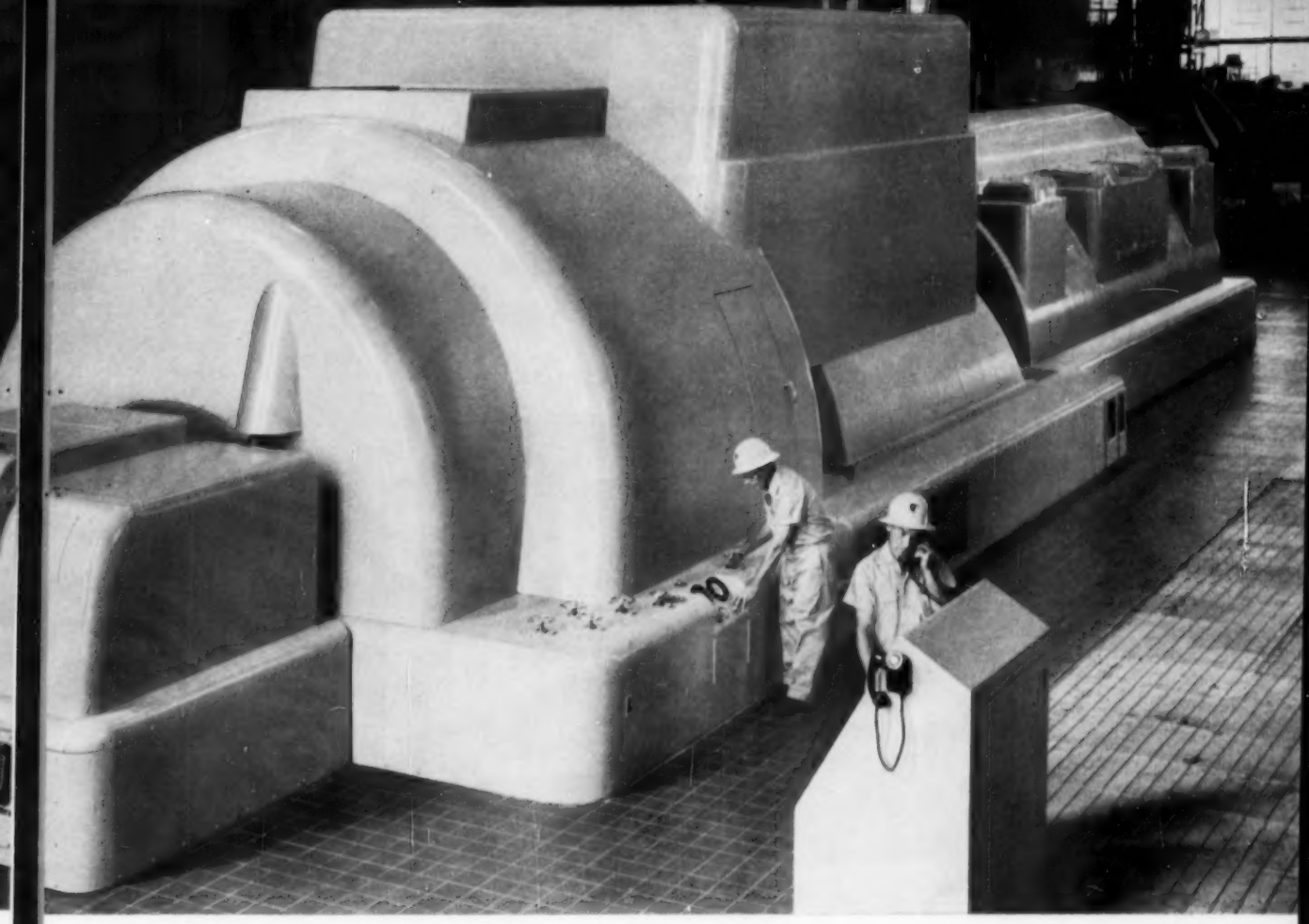
SPLIT-SECOND RESPONSE to system disturbances helps keep units like this on-the-line. Pictured here is a 150,000 kw reheat steam turbine-generator at Oklahoma Gas and Electric Company's Riverbank Station.



Split-second response helps keep



CONTROL AND INTERCEPT VALVES, located close to the point of steam admission, reduce the amount of high-energy steam entrained downstream from the closed valves—steam that could cause excessive acceleration and resultant tripout.



General Electric turbines on-the-line

SENSITIVE GOVERNING SYSTEM COPES WITH TEMPORARY SYSTEM DISTURBANCES

Requirements for sensitive, faster-responding governing systems have steadily increased with the trend toward larger reheat turbines with their inherent high overspeed potential.

Modern turbines entrain significant quantities of high-energy steam downstream from control and intercept valves and in crossover pipes. Because this steam can cause rapid acceleration upon load loss, governing systems must instantly sense speed changes to ride through temporary system disturbances. A split-second time lag may mean the difference between tripout and continued turbine availability.

Locating control and intercept valves as close as possible to the turbine operating stages reduces the amount of high-energy steam trapped downstream from the valves. With the acceleration potential of this entrained steam kept to a minimum, overspeed is limited and the turbine remains on governor control despite temporary system interruptions.

Other refinements such as use of an extremely sensitive governor and relays help make fast response possible. This governor senses the slightest change in speed and transmits a signal to activate the governing system.

Sensitive response of governing systems is another example of how General Electric turbine research and engineering leadership combine to build tomorrow's turbine-generators today. For further information on reheat turbine overspeed protection, write for bulletin GER-920, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York. 254-39

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GENERAL ELECTRIC

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call KE for plant expansion or new facilities

call KE for plant expansion or new facilities

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Engineering Test Reactor, National Reactor Testing Station, Idaho. Designed and built by KE—on schedule and within estimate!

The Engineering Test Reactor, Food Irradiation Reactor, Hanford Production Reactors, Aircraft Nuclear Propulsion Testing Facilities—these represent some of the nuclear energy projects performed by Kaiser Engineers. In each case, KE ingenuity produced efficient, lower cost facilities.

KE's Nuclear Engineering Division has the highly specialized skills and experience required to undertake complete design and construction of nuclear research, production or power generating facilities. Call KE for planning or building your nuclear project.

KAISER ENGINEERS engineers—contractors
Contracting since 1914

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*Wholly owned subsidiary of South Carolina Electric & Gas Co.

REPUBLIC *Automatic* COMBUSTION CONTROLS *Anticipate* FUEL-AIR-WATER REQUIREMENTS!

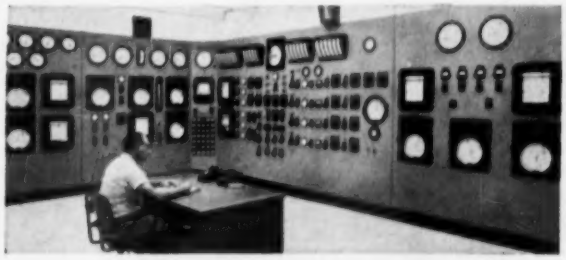
● Adjusts fuel, air and water as steam flow changes ● Makes follow-up adjustment of header pressure and water level if needed ● Prevents (rather than corrects) most pressure, level and temperature fluctuations before they happen!

Planned expansion of power in the Southeastern United States is typified by the addition of Unit #3 to South Carolina Generating Co.'s Urquhart Station. Rated capacity of the steam generator is 700,000 lb/hr at 1825 psi, superheated to 1010 F and reheated to 1010 F. Designed by Gilbert Associates, Urquhart #3 is modern in performance as well as appearance.

REPUBLIC's "Electronic Master" combustion control and triple-element feedwater control permit firing of pulverized coal, natural gas, or both at once without fluctuation of header pressure or water level. This system starts adjusting fuel, air and water as soon as steam flow changes perceptibly, not waiting for either drum level or header pressure to change.

If either of these factors change despite the preliminary adjustment, the change will be very small and will be offset immediately by a follow-up control that modulates the existing control signal. Since the flow of flue gas is held in such close proportion to the steam flow, temperature at the superheater outlet is held very close to a constant 1010 F despite load swings.

This advanced control system is a logical partner to the advanced thinking apparent throughout Urquhart #3. The quick action of electronic control added to the traditional reliability and power of pneumatic actuation produces a stable, accurate, dependable automatic system. And any one or all of the automatic control functions can be cut out at will to permit substitution of remote manual control at any time. Manual controls include indicators for electronic loadings of the regulators and positioners as well as position and rate of response indicators.



Control room of Urquhart Station's modern Unit #3.

NEED HELP on "Early Stage" Planning?

Remember that Republic, too, is planning ahead. To get the latest information on developments that will effect control in your future power or processing plant, contact the REPUBLIC Engineering Department as soon as such help would be beneficial.

REPUBLIC FLOW METERS COMPANY

A Subsidiary of Rockwell Manufacturing Company

2240 Diversey Parkway, Chicago 47, Illinois

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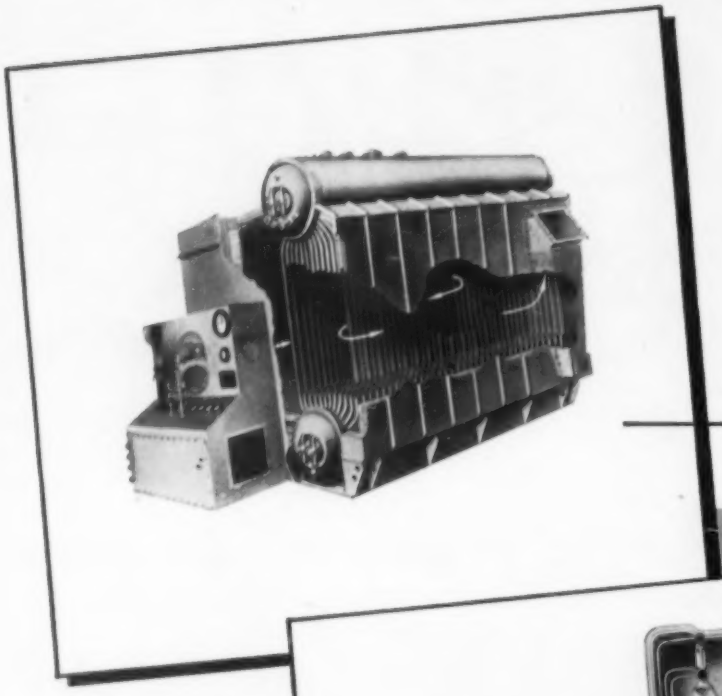
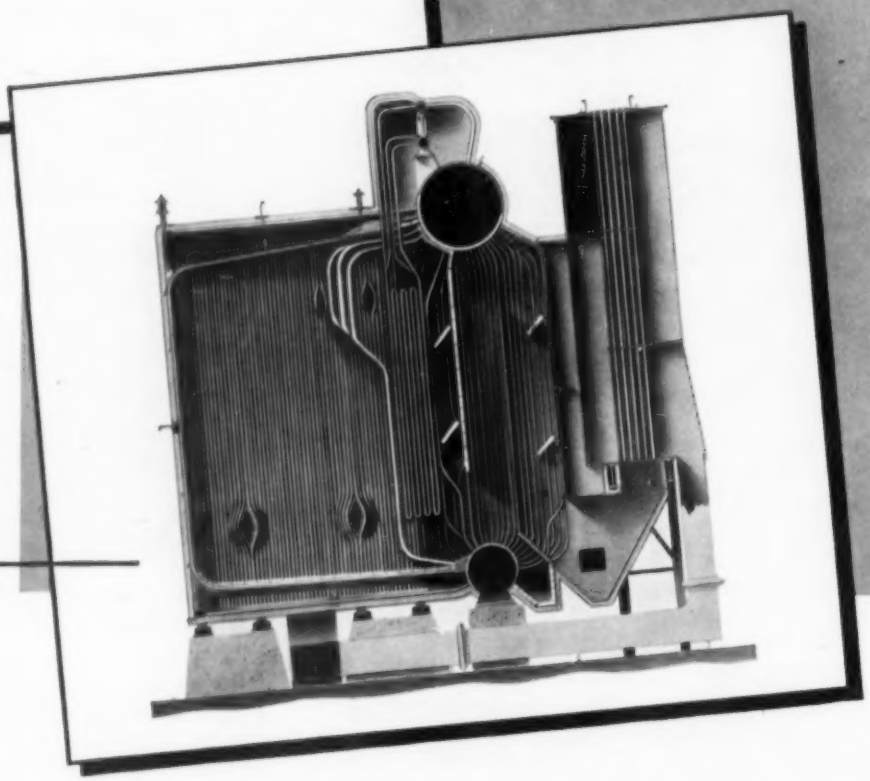
MODERN OIL AND



C-E Package Boiler—Type VP

Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.



C-E Vertical Unit Boiler —Type VU-55

Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.

COMBUSTION

Combustion Engineering Building

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING

GAS FIRED BOILERS

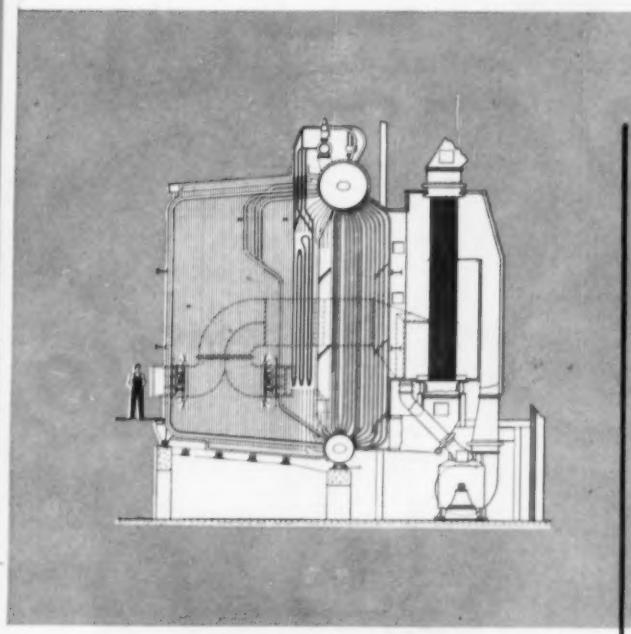
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units shown on the left page (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

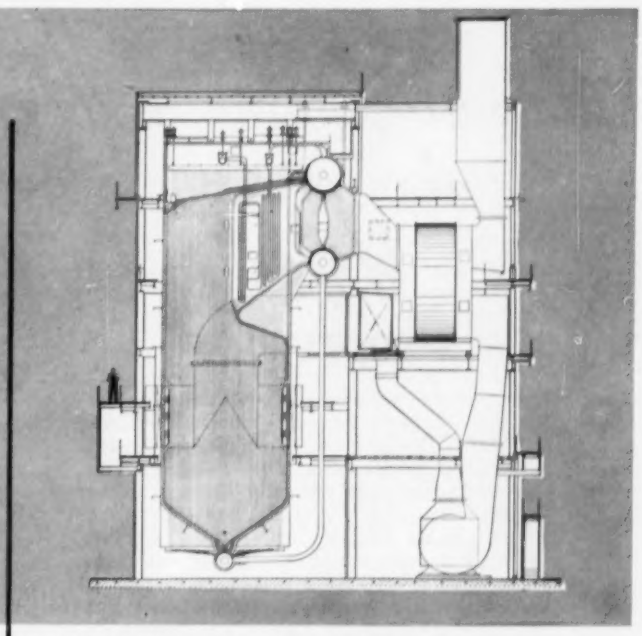
Please feel free to call on us for further detailed information. Catalogs are available upon request.

B-922



C-E Vertical Unit Boiler—Type VU-50B

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.



C-E Vertical Unit Boiler—Type V2

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.

ENGINEERING

C-E

200 Madison Avenue, New York 16, N. Y.

SYSTEMS • PRESSURE VESSELS • HOME HEATING AND COOLING UNITS • DOMESTIC WATER HEATERS • SOIL PIPE

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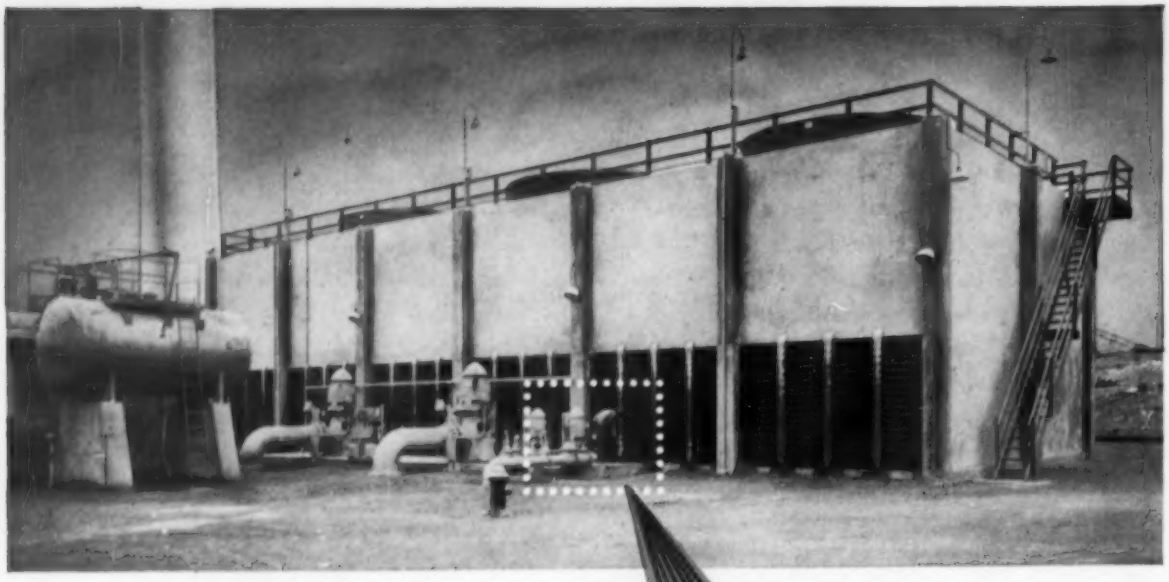
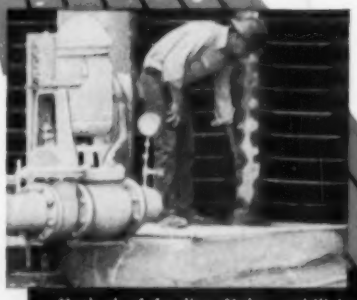


Unusual Cooling Tower

gets proven *Nalco* protection

This unusual cooling tower was built for the Riverside Cement Company at Oro Grande, California. The advanced design provides for concrete exterior walls which support and enclose fan units and redwood interior cooling vanes . . . The entire "working sections" of the tower can be repaired or replaced without affecting the structural strength of the shell. Nalco System Treatment protects this cooling system against scale and corrosion — has protected it effectively since it was first put in operation over two years ago. You can get the same complete water treatment protection, promptly, from Nalco. Write for details.



Method of feeding Nalco stabilizing treatment to this system is simplicity itself. Formula is supplied in ball form. Once each shift a perforated tube suspended in the tower basin is filled with balls which slowly dissolve in the cooling water.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois

CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
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SPAIN: Nalco Espanola, S.A.

THE *Nalco*® SYSTEM ...SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

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HELPFUL BULLETINS

PUMPS, COMPRESSORS

101 Centrifugal Pumps — Form 7062-C, 16 pp, features company's general-purpose, centrifugal pumps, which are horizontally split to permit accessibility of internal parts without disturbing suction and discharge piping. Describes advantages and incorporates cross-sectional drawings, installation views, selection charts, dimensions. Ingersoll-Rand Co.

102 Controlled Volume Pumps — Bulletin 557 describes controlled volume pumps designed to provide low-cost metering and pumping of non-corrosive liquids at normal temperatures with repeatable accuracy. Contains specifications, design features, dimensions and ordering data. Milton Roy Co.

103 Glassed Pump — A glassed centrifugal pump for handling corrosive liquids in the chemical process and allied industries is described in Bulletin 725.2. Dimensions, specifications, performance curves, other information are included in the 12-pp booklet. Goulds Pumps, Inc.

104 Pumps, Coolant Systems — Catalog 257, 24 pp, describes condensate units, coolant systems and general purpose pumps. Contains a diversified listing of pumps from the midget sized to sealed automatic pumps of great capacity and others designed for handling of chemicals. Photos and cutaways show various models and design features. Application suggestions, prices given. S. Gelber & Sons, Inc.

105 Pumps For Refineries — Bulletin 457, 16 pp, describes latest techniques in controlled volume pumping and their applications in the petroleum industry. Actual chemical metering systems used in pilot and research plants, water treating, crude desalting, catalyst preparation, corrosion control and continuous grease preparation are covered, as well as systems for metering product improvers and additives, others. Specifications, capacity-pressure charts included. The Milton Roy Co.

FANS

106 Propeller Fans — Bulletin A-109C, 32 pp, covers company's line of propeller fans, including standard propeller, utility, cool-blast, Lo-Noise, reversible and Bi-Pass duct fans, intake air units and unit heaters. Contains new fan sizes not shown in previous edition as well as revised air deliveries, specifications, performance data and dimensional drawings. Hartzell Propeller Fan Co.

107 Semi-Pressure Fans — Bulletin 400, 8 pp, covers semi-pressure fans for good performance against static pressures normally considered above the range of propeller-type fans. An insert page tabulates ratings. Aerovent Fan Co., Inc.

INSTRUMENTS AND CONTROLS

108 Stainless Steel Meter — Bulletin 94/10 describes a stainless steel industrial meter designed for measurement of corrosive liquids. Included are detailed cutaway illustrations, meter and register specifications, and a list of liquids that can be measured. Neptune Meter Co.

109 Air Velocity Meter — Bulletin 2448, 8 pp, gives complete information on company's velometers, designed for instant, direct reading of air velocities. Performance characteristics are detailed and volume determinations discussed. Illinois Testing Laboratories, Inc.

110 Industrial Tachometers — Twelve-pp Bulletin GEC-1258A describes the variety of generators and indicating or recording instruments available for measuring speed of any industrial rotating equipment, including a-c and d-c tachometer generators and hand tachometers. Photos and dimensional diagrams illustrate text. General Electric Co.

111 Pressure Gages — Catalog G-52, 32 pp, describes a complete line of pressure instruments for industrial, processing and chemical applications. Explains how the gages work, types of systems, adjustments, and applications, and includes dimensional drawings and specifications. Helicold Gage Div., American Chain & Cable Co., Inc.

112 Air Brake Operator — Bulletin V-604 describes a complete line of power operators for actuating company's screwed gland type, wrench-operated valves. Size, cylinder diameter, cylinder stroke and list price are tabulated, and standard installation and special installation illustrated. Rockwell Mfg. Co.

LUBRICANTS

114 Multi-Purpose Greases — Bulletin 127 describes advantages of a group of greases formulated with a non-soap, organic-type thickener, developed especially for use in applications where extreme heat or excessive moisture may be present. Typical test data included, as well as photos showing characteristics of the line. Standard Oil Co. (Ind.).

115 Versatile Grease — Brochure 6-206 covers properties and performance of a versatile silicone-based grease. While developed primarily for high-temperature, slow speed bearings, it is used for everything from worm-and-pinion sets to compressor engine injector valves, and from hold-down bolts to plastic extruder nozzles. Examples of these and other applications are discussed. Dow Corning Corp.

PIPING, VALVES, TRAPS AND ACCESSORIES

116 Plastic Pipe, Fittings — This 16-pp catalog, Form 10M557, describes advantages and applications of company's rigid high impact plastic pipe and fittings. Also covers chemical resistance ratings, electrical properties, physical properties, working pressures and pressure drop. An extensive fittings section is included, as is one on installation. Plastic Pipe Div., Triangle Conduit & Cable Co., Inc.

117 Asbestos-Cement Sewer Pipe — This 8-pp brochure describes company's asbestos-cement sewer pipe and infiltration-proof coupling. In addition to listing sizes and types, it also describes features and advantages. Keasbey & Mattison Co.

118 Valve Guide — Catalog 57 features 244 pp of useful information on company's gate valves, check valves and fire hydrants in a broad range of types. Profusely illustrated and diagrammed, the catalog is noted for simplified presentation of engineering data, application tips, valve accessories information, and reference data on materials, specifications and standards. Book is available to qualified power engineers. Please state your job title. Darling Valve & Mfg. Co.

119 Steam Traps — Quik-Flex thermostatic steam traps for outdoor and nonfreeze service are described in Bulletin 257. Itemizes typical uses for these traps. Specifications and capacities are given in tabular form, accompanied by dimensional drawings. A piping diagram shows recommended installation method. The V. D. Anderson Co.

120 Insulated Piping — Bulletin 57-1, 24 pp, on prefabricated insulated piping systems, shows typical uses for Hel-cor pipe units for underground or overhead pipe systems. Also describes Utilidor conduits for protection of underground utility services. Sample specifications are given, along with conduit sizing charts and trenching dimensions. Ric-wil, Inc.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 115 and 116.

121 Entrainment Separator — Impervious graphite entrainment separators are described in Catalog Section S-6900. Tables list separation efficiencies at average flow rates for various liquid particle sizes from 1.7 to 11.0 microns, and give complete unit dimensions, working pressures, and entrained liquid capacities. National Carbon Co.

122 Ball Joints — How to handle thermal expansion and contraction in piping with company's ball joints is outlined in 6-pp Bulletin 31. Illustrations of the 4 basic motion principles, photos of typical applications and comparison data are included. Barco Mfg. Co.

FILTERING

123 Small Filters — Bulletins 615 and 506 cover company's line of redesigned small filters. The first describes small filters in carbon and stainless steel, and provides specifications, dimension drawings, cross section views and typical systems. The second bulletin provides similar data for small corrosive liquid filters. The R. P. Adams Co., Inc.

124 Laminated Disc Filter — Bulletin 7C, 16 pp, provides complete informa-

tion on the design, construction, specifications and capacities of standard, high pressure and duplex laminated fiber disc filters. Also included are special purpose assemblies, accessories and installation data. Wm. W. Nugent & Co.

INSULATION

125 Insulation Price Manual — Net prices for pipe insulation can be read directly from tables in the 28-pp "Manual of Plus Values." Beginning with a table of list prices for 186 basic sizes and thicknesses of insulation, the handy manual presents 50 tables showing net prices for these same items using from 1 to 50 per cent plus discount. Net prices are found by cross-reference to insulation thickness and pipe size on the proper table. Union Asbestos & Rubber Co.

126 For Cold Pipes — Sizes, prices and technical data on Styrofoam low temperature pipe covering are provided in Form PL3128-755. Covers anti-sweat, light, standard and heavy-duty wall thicknesses pipe covering as well as fitting covers and vessel-tank insulation. Glo-brite Products, Inc.

ELECTRICAL

128 Normal Speed Motors — This 12-pp brochure describes company's complete line of normal speed motors. Illustrates several electric motor applications and contains selection data, cutaway view showing design features, and torque characteristics selection chart. Sterling Electric Motors, Inc.

129 Induction Motors — Bulletin GEC-1419 gives application data, types, ratings, frame sizes, and construction features of dripproof and enclosed single-phase induction motors, used for fans, blowers, pumps, air and refrigeration compressors, conveyors, masonry saws, etc. Construction features are detailed on cutaway view, and dimension tables included. General Electric Co.

130 Why RM Transformers — Twelve-pp Bulletin GEA-6617 shows how RM (repetitive manufacture) standard-design transformers can be applied where a special unit seems to be required. Explains what is meant by an RM transformer, why emphasis is placed on RM's and what is gained by using them, listing application areas. Also shows how economies can be effected by applying RM transformers on systems with non-standard voltages in parallel with units having non-standard impedance, and how to satisfy non-standard top requirements. General Electric Co.

131 Plug-In Busway — Bulletin GEA-6470, 18 pp, describes features and advantages of company's plug-in busway that permits a direct plug-in to the bus bars, even when the run is energized to feed lighting and power loads. Functions and applications are detailed, arrangement of components illustrated, and ratings, weights, dimensions and technical data included. General Electric Co.

132 Lighting-Type Busway — Twelve-pp Bulletin GEA-6170 covers a lighting-type busway, rated 50 amp, 300 v. It is available in two-, three- or four-pole construction and designed for use as power supply for lighting fixtures, small power tools and machines. Bulletin gives detailed application information. Lists short-circuit ratings, voltage drop, dimensions, weights, installation details and methods of hanging. Also included is a brief description of company's new roll-in method of installing this busway. General Electric Co.

133 Control Centers — Publication EL-174, 32 pp, describes company's Unitrol, a standardized motor control center. Features Unitrol's new concept of modular design, which presents a variety of motor control in a central structure. Generously illustrated with photos, charts and layout plans, it presents varied applications and engineering data for aid in selection, planning. Cutler-Hammer, Inc.

134 Low Voltage Control — Advantages of low voltage control — a modern method of switching lighting and appliance loads in commercial, industrial and other installations — are described in this 12-pp manual. Explains flexibility, safety and versatility of the system, describes components which make up the control, and includes installation data, wiring diagrams, and typical specifications. Square D Co.

135 Power Switches — Vertical-break power switches are described in 12-pp Bulletin PSE2. Gives operating, electrical and mechanical features which make PV2 switches applicable to high voltage circuits. Line Material Industries.

136 Contactors — Catalog 57-83, 28 pp, describes a line of contactors for power circuit control. Covers a-c and d-c magnetically held contactors and specialized magnetic contactor panels. Advantages, application, construction and ratings are detailed, and photos, drawings, outline dimensions and wiring diagrams included. Automatic Switch Co.

137 Starters, Contactors — Motor starters and contactors in Sizes 4, 5 and 6, 50 to 400 hp, are described in 12-pp Bulletin 14B8615. Discusses advantages offered and explains in detail the ACBO arc centering blowout incorporated. Units presented are applicable to many types of drives including pumps, crushers, blowers, fans, screens and furnace controls. Allis-Chalmers Mfg. Co.

138 Solenoids — General information and technical data on solenoids for a wide variety of standard and special applications is featured in 12-pp Catalog 57-85. Engineering specifications are included, as well as photos, dimensional diagrams and pull curves for various solenoids. Automatic Switch Co.

139 Insulating Materials — Booklet B-7206, 8 pp, discusses types, characteristics, and applications for shellac- and varnish-coated papers, varnished fabrics, slot cell insulation and organic varnished glass, as well as silicone varnished glass, silicone rubber-coated glass cloth, and semi-cured silicone-treated glass cloth. Insulating varnishes, enamels, primers, finishes, and compounds are also covered. Westinghouse Electric Corp.

You'll save time in ordering bulletins by using the Reader Service Cards on page 115. Of course we honor letterhead requests—but it takes us somewhat longer to handle them.

140 Fittings for Cable — Engineering Bulletin 135A, about 36 pp, covers company's line of interlocked armor cable terminators, cable supports and splicing sleeves for many types of interlocked armor cable installations. Includes general instructions for splicing, specifications, and price list. O. Z. Electrical Mfg. Co., Inc.

141 Electrical Fittings — Catalog 36 pp, describes electrical fittings, cable racks and wiring specialties for utilities and industrial plants. Illustrates installation details and pictures more than 90 products, including newest additions to company's line. Includes current prices, information on sizes and types of fittings in various metals. The M. & W. Electric Mfg Co., Inc.

142 Plastic Wiring Ducts — Low cost plastic wiring ducts for fast electrical control panel wiring are featured in this illustrated folder. Design features are detailed and three methods of mounting described. Panduit Co.

HEATERS

143 Stainless Steel Heaters — Complete description and specifications on stainless steel direct-fired heaters are included in 6-pp Bulletin F-57A-RO. Cutaway views, drawings and diagrams illustrating design and construction features are included. Reznor Mfg. Co.

144 Unit Heaters — Catalog 2557, 12 pp, gives performance data, complete wiring and piping diagrams, construction features and specifications on company's line of horizontal unit heaters. Information on proper mounting heights and length of air travel is furnished, as well as diagrams on all phases of construction and installation. Young Radiator Co.

DUST CONTROL

145 Improved Dust Separator — Bulletin 576, 12 pp, describes advantages of company's heavy duty high efficiency centrifugal dust separators. In addition to covering design improvements and applications, it features air flow resistance and dust recovery curves, temperature and pressure correction formula, selection chart, dimensions, supports and accessories. The Day Co.

146 Dust, Fume Eliminators — Catalog VRU-4-57, 8 pp, describes features and operating advantages of company's vertical rotor type dust and fume eliminators. Manual and conveyor clean-out design diagrammed and sizes are tabulated. Schmieg Industries Inc.

CORROSION PREVENTION

147 Steam System Treatment — Bulletin MA describes a liquid treatment for rust and corrosion in steam lines, return lines, radiators and steam heated processing equipment. Causes of rust and corrosion and action of the water treatment are explained. The North American Mogul Products Co.

148 Corrosion Inhibitor — This 6-pp folder describes a corrosion inhibitor for closed circulating water systems with or without anti-freeze. Lists advantages and includes schematic drawings illustrating applications in hot water heating systems, diesel engine cooling systems and others. Hagan Chemicals & Controls, Inc.

VOGT identification Disc...

...on top and in sight

makes it easy to identify valves —even in insulated lines

The Vogt tell-all identification disc, on every valve, is permanently located above the handwheel for complete and convenient identification. It shows valve size, catalog and drawing number, materials used for principal parts and primary pressure and temperature ratings. The flat on the handwheel protects the disc in assembly and in service.

Vogt GP Valves are available in a complete range of sizes from ¼" to 2", with HAYNES STELLITE* faced seating surfaces and rated 800 pounds at 850° F. and 2000 pounds at 100° F. (Other types are available through 8" size.)

*Trade-Mark of Union Carbide and Carbon Corporation

HENRY VOGT MACHINE CO.
P. O. BOX 1918, LOUISVILLE 1, KY.
SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va.

Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24A-PE.

Vogt GENERAL GP PURPOSE Vogt FOR BETTER VALVES

DROP FORGED STEEL VALVES

Adv. No. 7 in a series describing the features of Vogt GP Valves.

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COOLING TOWER POWER
is most efficiently utilized by
Marley
Multi-Blade Aerfoil Fans

Marley fans are unexcelled for the job of converting applied power to actual cooling performance, but the qualities that make them positively distinctive are ultra-smooth operation and long-life durability. It requires just two words—MULTI-BLADE and AERFOIL—to point out the characteristics that produce these stand-out advantages.

Watch a 22-foot, 12-blade Marley fan operate; listen to it operate. The customary "huff and puff" pulsation of large fans is not there. There is no structure-shaking vibration. The result? Longer life for speed reducer, drive shaft, fan cylinder and structure. That is the multi-blade advantage.

The Marley fan is inherently rugged and durable. Each blade is a single casting, a rigid, homogenous unit of specially selected aluminum alloy that retains its aerfoil shape permanently. Marley fans never develop tip-sag or service flutter. The design completely eliminates weld and rivet failures, skin cracks, imperfect laminations and internal corrosion.

All machine operations on Marley blades and hubs are carefully quality controlled. Blade surfaces are protected by a double-coated baked plastic finish. Each fan is balanced at the factory and match-marked for field assembly.

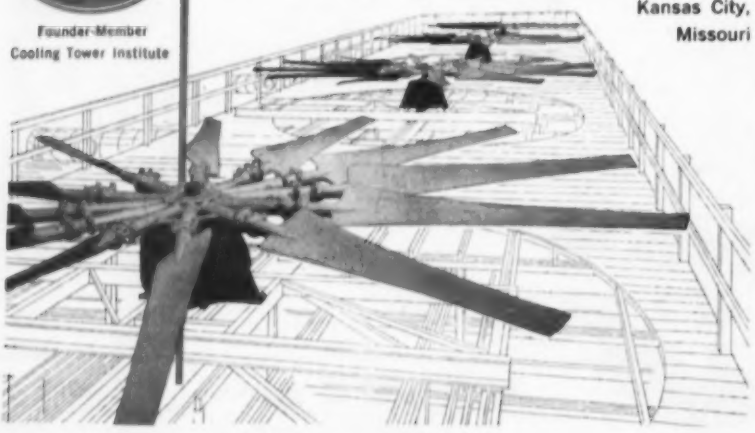
Owners of towers of all types and makes are modernizing their equipment by changing to Marley Multi-Blade Aerfoil Fans—often after side-by-side comparative test with present equipment. Write for Bulletin FH356 and get the complete story of modern design applied to cooling tower fans.

MARLEY

Founder-Member
Cooling Tower Institute

The Marley Company

Kansas City,
Missouri



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149 Corrosion Resistant Lining — An inexpensive and enduring solution to costly corrosion problems in industry, in the form of a low-soluble cement-base lining for the interiors of steel water heaters, tanks, vats and other vessels handling bulk liquids, is discussed in Bulletin PF 17. Results of performance tests are pictured and described. Pocono Fabricators Inc., Div., The Patterson-Kelley Co., Inc.

MECHANICAL POWER TRANSMISSION

150 Roller Chains, Sprockets — Catalog 757, 68 pp, on stock roller chains and sprockets, stresses advantages gained through use of roller chain and pictures some typical roller chain drives. Tells how to select a stock roller chain drive. Provides specifications, ratings, prices and engineering data required for ordering. Book is generously illustrated with photos, dimensional drawings. Diamond Chain Co., Inc.

151 Spherical Roller Bearing — Eight-pp Bulletin A668 describes design and operation advantages of company's Spher-Align pillow block with improved spherical roller bearing. Complete selection data and specifications are tabulated. Dodge Mfg. Corp.

152 Gearmotors, Package Drives — Eight-pp DB-3650 describes gearmotors and package drives, including horizontal, vertical, right angle, open, enclosed, explosion-proof, a-c and d-c units, with their respective reduction ratios and output speeds. Also covers construction and mounting details, and includes motor specifications. Westinghouse Electric Corp.

MATERIALS HANDLING

153 For Bulk Materials — Latest information on equipment for storing and handling bulk materials is contained in 12-pp Bulletin 574. Descriptions, specifications and dimensions of vertical and horizontal tanks are included. Cost savings afforded by bulk storage and handling facilities are noted. Pneumatic conveying systems, material handling accessories and custom fabricating are discussed. Typical installations illustrated. The Day Co.

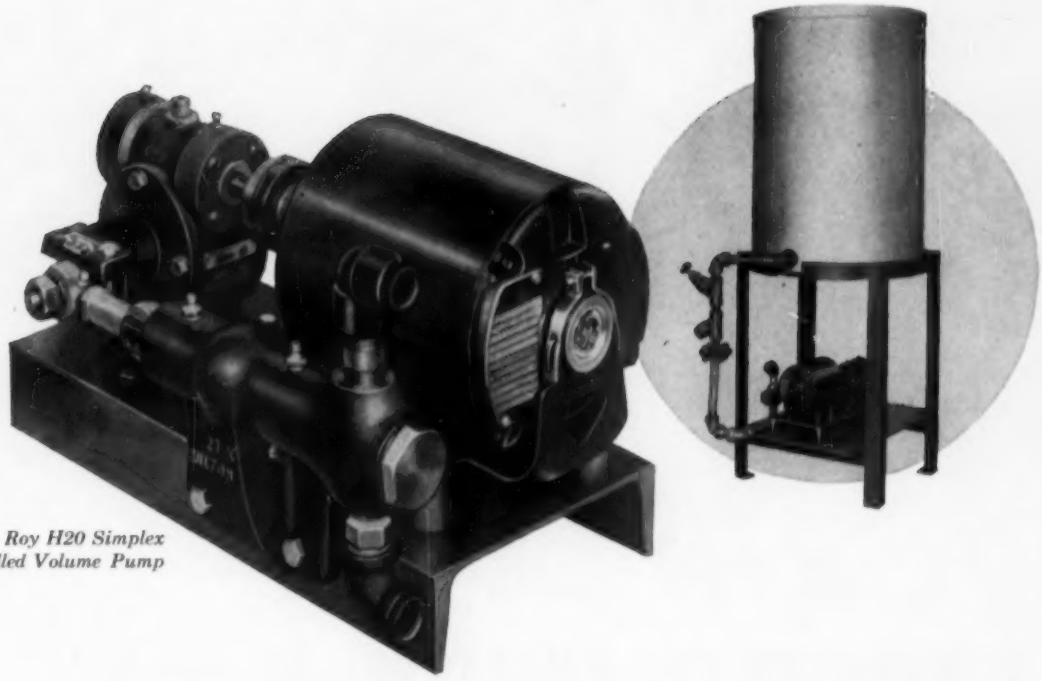
154 Pneumatic Conveying — Actual operation of the Airveyor, as used in the pulp and paper mill industry for handling process chemicals, chips, sawdust and hog fuel, is described in 12-pp Bulletin A-17. Typical installations are described, with schematic drawings and photos of each included. Fuller Co.

OTHER EQUIPMENT

155 Engineering For Atomic Power — How $400 million in coin silver weighing 14,000 tons were borrowed from the U. S. Treasurer for use as electrical conductors at the atomic energy plant in Oak Ridge, during the war when copper was scarce, is told in this 36-pp illustrated booklet. Describes the firm's role in the development of atomic energy and outlines its activities in peacetime applications of nuclear power. Stone & Webster Engineering Corp.

156 Thermoplastic Exhaust System — A summary of components necessary to design, fabricate and install a completely corrosion-proof industrial ex-

Typical packaged system for boiler-water treating ready for shipment includes an H20 simplex pump, a 50-gallon polyethylene tank, suction piping, close-off and relief valves. Standard tanks are available in steel, stainless steel and polyethylene, to hold 50 or 100 gallons. Write for Bulletin 953.



Milton Roy H20 Simplex Controlled Volume Pump

Low-cost Controlled Volume Pumps feed chemicals accurately

High metering accuracy, long service life, minimum maintenance and low cost are the big advantages of Milton Roy H20® Controlled Volume Pumps. They embody quality design features usually found only in higher priced pumps, including: self-aligning bearings . . . self-adjusting packing . . . double ball checks on suction and discharge . . . cartridge-type, easily replaceable valves . . . standard continuous flushing connections.

Both simplex and duplex models are available, and conversion from one to the other can easily be made in the field. H20 pumps can be quickly delivered from stock.

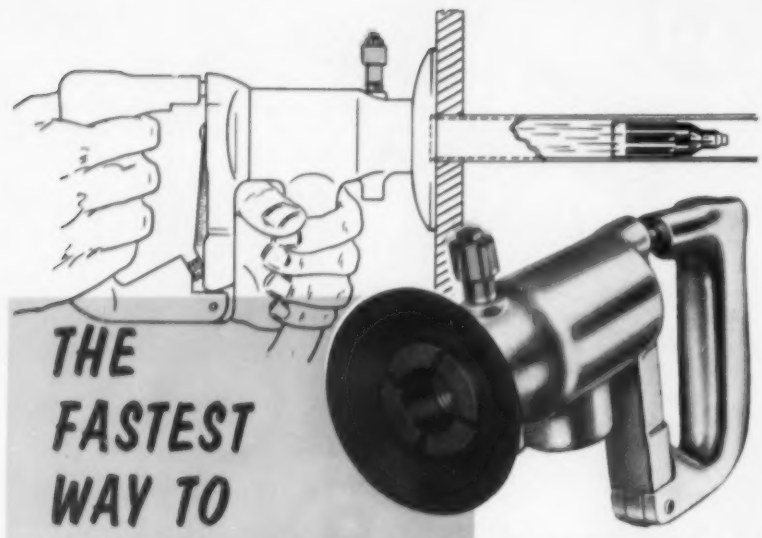
You can depend on H20 pumps to meter boiler-water treatment chemicals and other mildly corrosive and non-corrosive liquids. Write for Bulletin 557 and complete specifications.

Milton Roy Company, *Manufacturing Engineers*, 1300 East Mermaid Lane, Philadelphia 18, Pa.

milton Roy
CHEMICAL FEED SYSTEMS

Engineering representatives in the United States, Canada, Mexico, Asia, Europe, South America, Africa, Australia.

For more data circle 517 on Post Card



THE FASTEST WAY TO CLEAN CONDENSER TUBES

John Crane Super-Jet®

CONDENSER TUBE CLEANER

"John Crane" Super-Jet tube cleaning equipment offers the simplest yet most effective method for maintaining top heat transfer efficiency in steam condensers for these 5 reasons:

1. **EFFICIENT**—handy gun-and-slug method removes slime or scale in record time.
2. **VERSATILE**—interchangeable nozzles permit water or air operation. Slugs are available in types and sizes to insure positive cleaning under practically all conditions.
3. **SPEEDY**—one man can load an entire bank with cleaning slugs and shoot them through in rapid succession.
4. **ECONOMICAL**—slugs can be used over and over again. Rugged gun is built for long, hard service.
5. **EASY OPERATION**—simple-to-operate gun weighs only 2¼ lbs., does not require a skilled worker and can be used for lengthy periods without fatigue.

Request Bulletin P-324. Ask about special 10-day free trial offer.

Crane Packing Co., 6429 Oakton Street, Morton Grove, Illinois (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

Interchangeable Nozzles

Air or water operation—effective pressures 50-200 psi.

Slugs For All Services

Spool-type for normal slime removal, bullet-shaped for heavy or thick slime deposits and scraper-type for scale and mineral deposits. Latter two slugs have "jet action" holes that air or water-flush away deposits as removed.

CRANE PACKING COMPANY

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haust system from polyethylene is presented in this 12-pp bulletin, Volume 111. Describes centrifugal fans, ducting and fittings and hoods, and includes photos, drawings, dimensional data and diagrams. American Agile Corp.

157 Industrial Tools — Information on a complete line of industrial tools, including 500 new types and sizes never before offered, is presented in 120-pp Catalog 57. Included are complete lines of wrenches, socket wrenches, drop forged clamps, tool holders, set up and hold down tools, cutting tools and pipe tools. Photos, drawings and numerous charts and tables are designed to aid in selection of tools for a variety of industrial applications. Armstrong Bros. Tool Co.

158 Packaged Generator — Catalog 56A, 8 pp, describes company's factory assembled automatic gas or oil fired steam generators. Illustrates and describes features and operational advantages of the three-pass, fire tube units, and includes specification data and dimensional diagram. Erie City Iron Works.

159 Generating Plants — The revised edition of this company's Blue Book is a pocket-size 36-pp collection of general information on selection of engine driven electric generating plants. Traces electric plant development, from early stages where storage batteries were necessary, to modern single-unit engine-generator power plants. Describes three general groups of electric plants: a-c, d-c, and battery charging. Reviews three types of primer movers which furnish mechanical power for driving the generator: gasoline engine, diesel engine, and gas engine. Cost of operation and installation of each is discussed. Differences of engine cooling are compared, starting methods described and selection factors given. D. W. Onan & Sons, Inc.

160 Hose Reels — This 16-pp catalog describes hose reels for industrial applications. Completely illustrated with photos and cutaway views, it provides detailed information on features, applications, and offers specifications in easy-to-read tables placed alongside photos of the reels. Clifford B. Hannay & Son, Inc.

161 Condensing Units — General information and tabulated engineering data on company's line of ¼ through 3 hp semi-hermetic refrigeration condensing units and motor compressors are presented in Form G-124R. In addition to tabulating specifications, bulletin fully details important design and operation features. The Brunner Co.

162 Selecting An Engineering Firm — Practical advice on the selection of an engineering firm is offered in this 8-pp brochure. Developed in the interest of good management practice, it answers basic questions: need for an engineering firm, selection and results to be expected. The Teller Co.

163 For Watertight Masonry — Bulletin "O.M."-8A is a 6-pp folder on the subject of design and specification of watertight masonry. Outlines six considerations in designing tight masonry walls. The Master Builders Co.

164 Socket Screw Products — This 32-pp revision of company's basic Unbrako catalog reviews in detail the full line of socket screws, plugs, pins, and related products. Catalog includes detailed size-

Bailey Meters and Controls for Combustion, Feed Water, Steam Temperature and Condensate at Moores Park Station, City of Lansing, Michigan.

How Bailey makes steam operating duties a pleasure—

Fingertip Controls, convenient indicators and trend recorders make steam control room operating duties a pleasure. You get this bonus for your operators when you specify Bailey Meters and Controls.

Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs.

Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A133-1

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

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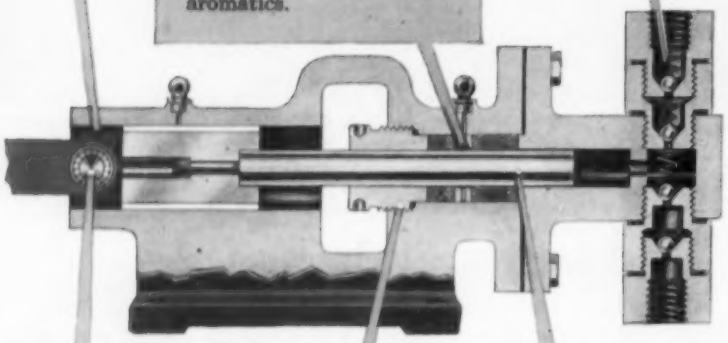
PICK THIS PUMP
for reliability and maintenance economy...

CROSS HEAD is oversized, running in carefully machined guide—preventing usual pump failures at this point. All moving parts and packing can be removed without breaking piping connections.

LIQUID ENDS: Valves are machined from solid stainless steel. No pressed seats to work loose. Valve balls are hardened and ground, and stainless steel spring-loading insures instant response, even on viscous liquids and slurries.

LANTERN RING readily changed from grease to water or oil seal for handling crystallizing liquids, slurries, corrosives, volatile toxics, aromatics.



CONNECTING ROD BEARINGS—hardened and ground pins running in grease lubricated needle bearings, replace the usual rapidly-wearing bronze bushings.

PISTONS are stainless steel, ground and polished. Accurate capacity control is obtained by piston stroke length adjustment. Adaptable to both manual control and instrumentation.

PACKING GLANDS are easily accessible at both ends to simplify packing replacement. Gland take-up is a screwed nut, insuring even pressure on packing—no cocking, less packing trouble.

For more facts about Philadelphia type S Pumps — for 85% of all chemical pumping needs — write for Bulletin S-1254.

PHILADELPHIA PUMP DIVISION OF AMERICAN METER COMPANY
13500 Philmont Ave., Phila. 16, Pa.

PHILADELPHIA PUMP

DIVISION OF AMERICAN METER COMPANY / EST. 1836

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by-size data on diameters, thread specifications, lengths and packing and shipping information in addition to general information on product advantages and applications. Standard Pressed Steel Co.

165 Fire Protection Systems — How an investment in automatic sprinkler protection can amortize itself out of insurance savings, and bring many other economic benefits, is explained in 8-pp Bulletin 78. Included are case histories of systems which paid for themselves within 2½ to 8 yrs. Automatic Sprinkler Corp. of America.

166 How to Braze Stainless — Bulletin GER-1331 is an 8-pp technical article discussing filler metals, wetting, fixtures, distortion, protective atmospheres, and other aspects of furnace brazing on stainless steels. Photos illustrating brazing process and equipment are included. General Electric Co.

167 Supplies and Equipment — This 1957 Estimating Catalog is a 36-pp pricing guide to company's heating, ventilation, refrigeration and air conditioning equipment. Quick selection and pricing of blowers, fans, coils, evaporative condensers, valves, and fittings is made possible by means of specially prepared tables. Profusely illustrated with photos, drawings and diagrams, catalog includes data on company's extended line of air conditioning units, cooling towers and evaporative condensers to 100 ton, and pricing on Tru-Air heating and cooling coils. M. Blazer & Son.

168 Tape Selection Guide — Tapes for permanent moisture sealing, rapid insulation build-up, permanent cable jacketing, high-voltage cable splicing, and general insulating purposes are shown in this 8-pp catalog. Contains general information, recommended uses, packaging details and data charts showing test results on each product. Bishop Mfg. Corp.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

169 On Nuclear Filtration — Catalog 54–102 is a 6-pp folder covering a line of filters and filtration systems for use in nuclear power and research applications. Describes characteristics of the various filter types and media used in the nuclear field and lists 15 principal types of applications for which the units are produced. Cuno Engineering Corp.

170 For Cement Mill Service — Included in this 24-pp bulletin on products for cement mill service are selection tables to aid in obtaining right chain, buckets, bucket spacing, head shaft wheel diameter and rpm, foot shaft sprocket and size and casing size. Drive selection data is also included. Steel chains, sprockets, buckets, gravity take-ups, bearings and drag chains are pictured and described. Also provided is information on belt conveyor idlers and pulleys and apron feeders. Chain Belt Co.

IPS—BUTT WELDING FITTINGS
½"-42" From Sch. 5S to 4" Walls

ASA and MSS FLANGES
½"-24" 150 through 2500 lbs.

LADISH

FOR

Complete Service

IN

Controlled Quality

TUBE O.D.—BUTT WELDING FITTINGS
½"-36" From .049" to .250" Wall

LARGE O.D. and TEMA FLANGES
Up to 20' in Diameter
LONG WELDING NECKS
1"-24" 150 through 2500 lbs.

FORGED AND WROUGHT FITTINGS

CARBON • ALLOY
STAINLESS STEELS
AND ALUMINUM

UNIONS
⅛"-4" 150 lbs. and 2000 through 6000 lbs.

SCREWED and SOCKET FITTINGS
⅛"-4" 150 lbs. and 2000 through 6000 lbs.

WHATEVER your fittings requirements . . . regardless of the type, size, wall thickness, pressure rating or material specification . . . you can get prompt, efficient, *complete service* by specifying LADISH and ordering from your local Authorized Ladish Distributor.

A broad, full-range line produced to unsurpassed standards of metallurgical and manufacturing integrity . . . plus adequate distributor stocks . . . gives you double assurance of satisfaction.

For complete service on your fittings requirements . . . call your Authorized Ladish Distributor.

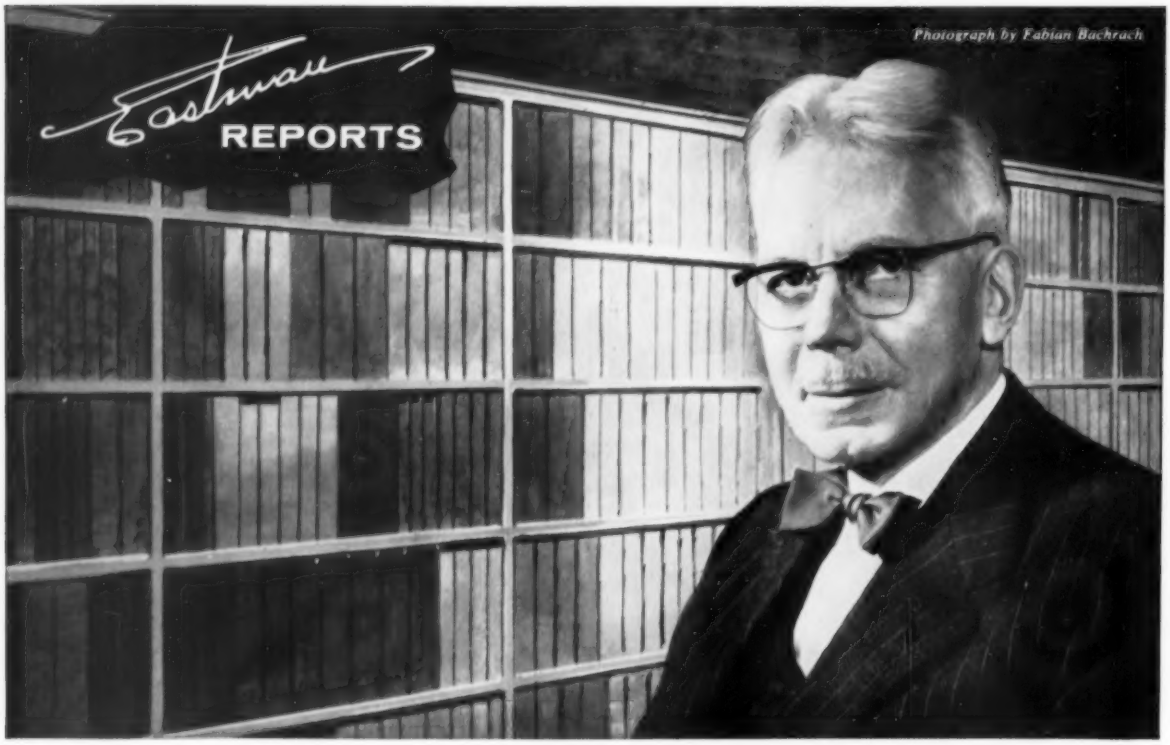
Catalogs available on request. Please indicate specific product lines for which information is desired.

THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

District and *Regional Offices: New York • *Baton Rouge • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul • St. Louis • Atlanta • Houston • *Odessa • Tulsa • Denver • Los Angeles • *San Francisco • *Seattle • Havana • Mexico City • Brantford, Ont.



Eastman's confidential Editorial Research Reports to publishers prove that readers find advertising in Business Publications as interesting as editorial material. The full Eastman release on this subject is available to you on request.

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says **ROY EASTMAN** of the Eastman Research Organization

"Why shouldn't it be," Mr. Eastman continues, "since Business Publications advertise the very things by which readers make their livings?"

"A year and a half ago, we injected into all of our confidential readership surveys a penetrating inquiry as to *how* the advertising was read.

"The overall results of a year's inquiry on this subject (32 surveys for 18 publications) show that the average exposure to advertising is *70% intentional*, only 30% accidental.

"Moreover, 94% of the readers of these publications, on the average, reported that they gave conscious attention to the advertising."

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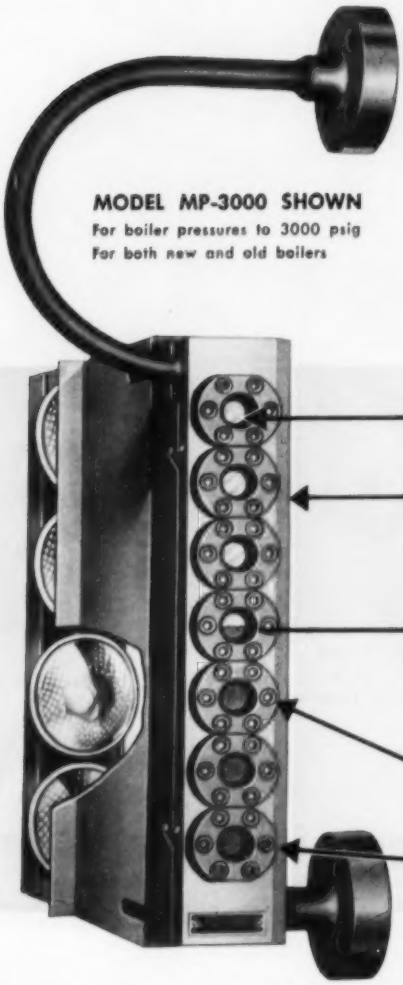
NATIONAL BUSINESS PUBLICATIONS, INC. *1413 K Street, N. W., Washington 5, D. C. • STerling 3-7535*

The national association of publishers of 173 technical, professional, scientific, industrial, merchandising and marketing magazines, having a combined circulation of 4,098,937 . . . audited by either the Audit Bureau of Circulations or Business Publications Audit of Circulation, Inc. . . . serving and promoting the Business Press of America . . . bringing thousands of pages of specialized know-how and advertising to the men who make decisions in the businesses, industries, sciences and professions...pin-pointing the market of your choice.

Write for a list of the NPB publications and the "Here's How" booklet, "How Well Will We Have to Sell Tomorrow?", written by Ralston B. Reid, Advertising & Sales Promotion Manager of the Apparatus Sales Division, General Electric Company.

MORE THAN ~~950~~ 1400 DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ 300 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED

WATER SHOWS GREEN

Also available is Model MP-900 for boiler pressures to 900 psig

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 1400 for central station generating plants, more than 150 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174AB (Model MP-3000) or Bulletin 2044AB (Model MP-900) for more information.

Diamond

7801

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*

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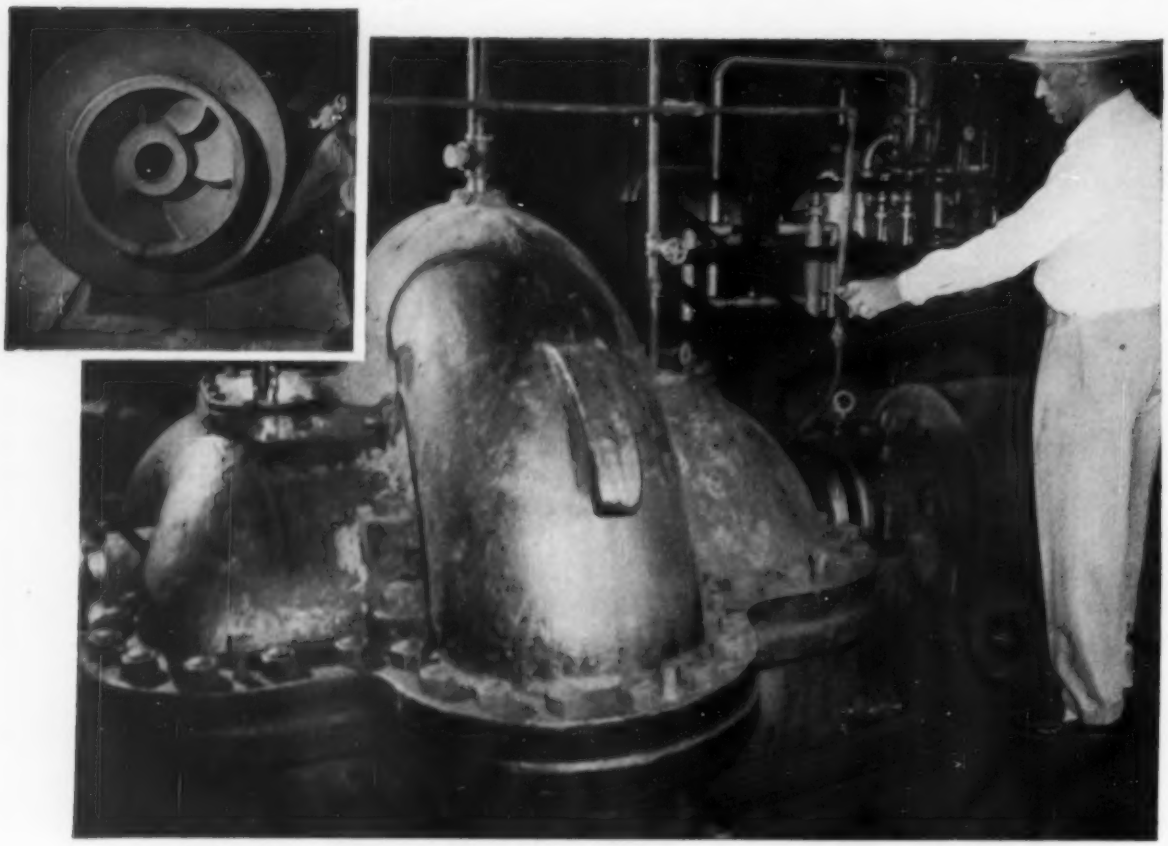

No Slow Joe. This power plant pump handles 240,000 gallons of salt water every hour. Its 2,200-pound impeller – cast by the INCO Foundry at Bayonne, N. J. – is shown at upper left. To meet Caloil demands for *utmost* corrosion resistance, it's made of *Monel!*

Pumping salt water at 40,000 gpm

Monel impeller helps coastal power plant end threat of breakdown by corrosion

The California Oil Company has a big industrial power plant at Perth Amboy, New Jersey. Right at hand is all the water they need for their cooling system.

But it's *salt* water. And you know how destructive that can be . . . what corrosion it can cause.

So Caloil had an impeller of Monel* nickel-copper alloy put in. Weighing 2,200 pounds, it was specially cast at INCO's Foundry in Bayonne, New Jersey.

This large Monel casting has excellent resistance to corrosion. And it's *tough*, too! Actually, Monel lends more strength than the impeller *needs* to stand centrifugal stresses and plenty of hardness to resist wear.

Over and over, that's the way it is with Monel. It gives you an *extra* margin of performance. Helps make your equipment last longer. Helps keep your maintenance expense low. And helps make downtime less of a threat!

There are probably *many* ways Monel can save money for you. Find out more about them. Ask for "Engineering Properties of Cast Monel" and "Cast 'S' Monel." Write today!

*Registered Trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

More POWER for you . . . with MONEL INCO TRADE MARK **NICKEL ALLOYS**

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~~Kill Algae~~

Get SAFE, QUICK CONTROL at Low Cost

Allis-Chalmers No. 120 Series Algaecide eliminates fouling of cooling tower systems by algae and slimes

Check the many exclusive advantages of Allis-Chalmers No. 120 Series algaecide:

- Easy to introduce into the system by means of pump, drip feed or manual feed. No expensive feeding equipment required.
- Safe to handle. Even in concentrated form, it is no more than a mild irritant to skin, eyes and mucous membranes.
- Low toxicity to fish or animals.
- Non-oxidizing.
- Inhibits corrosion.
- Dosage is independent of organic, ammonia, or nitrogen content of makeup water.
- No loss on passage through tower.
- Proved effective in field use.
- Only 2 to 5 ppm required for effective dosage of most organisms.

This is the most effective algaecide known. If you have a problem with plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

ALLIS-CHALMERS

A-5442

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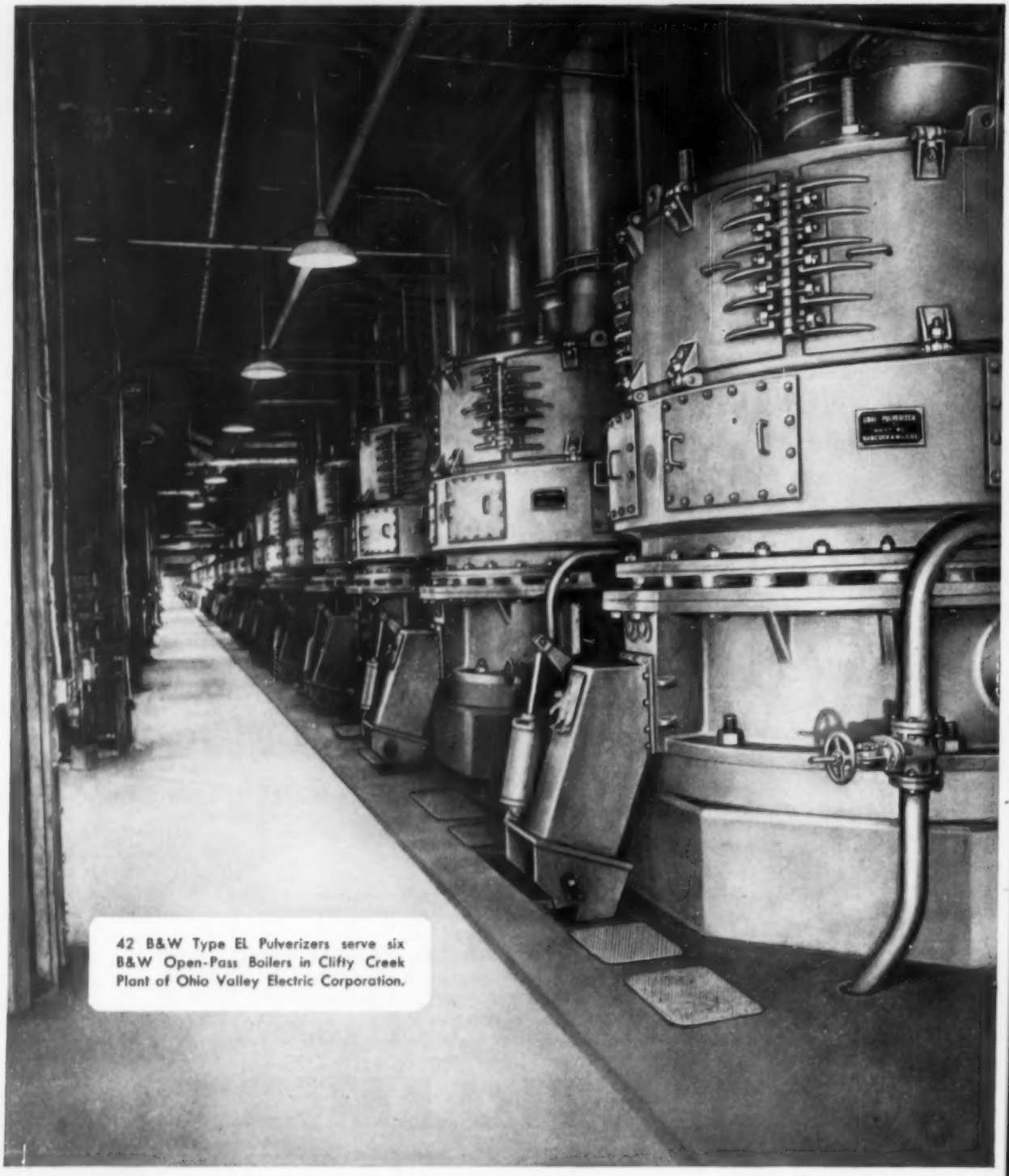
Have You Investigated

THE MODERN B&W



42 B&W Type EL Pulverizers serve six B&W Open-Pass Boilers in Clifty Creek Plant of Ohio Valley Electric Corporation.

DIRECT-FIRING SYSTEM?

A Compact, Space-Saving Package of Efficient Grinding Power

More power and capacity in a compact arrangement . . . long-range dependability . . . reduced operating cost — these are the measurable results of continuous, intensive development of the modern B&W Pulverizer. It has established an outstanding production and efficiency record in thousands of commercial installations. Here are some reasons why:

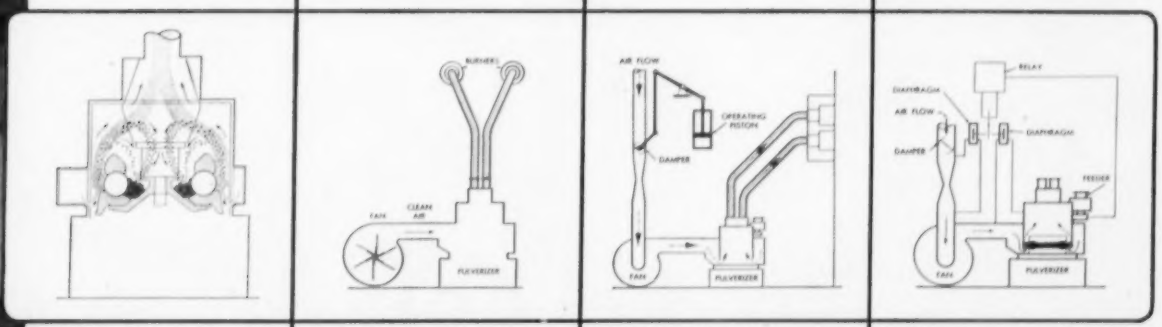
Continuous High Fineness Over Entire Service Life: Efficient combustion requires high fineness at all times. The high circulating load of the B&W Pulverizer permits efficient and dependable classification of product, so that only material of proper fineness leaves the unit. In addition, its slow-speed, spring-loaded ball bearing grinding elements maintain proper grinding contact throughout their service life.

Handles Wide Variety of Low Grade and Wet Coal: Regardless of the coal's grade or whether it's dry or soaking wet, the B&W Pulverizer's unique and exclusive recirculation of fuel through heated air assures efficient grinding . . . eliminates shutdown, capacity loss, or special attention from operators.

Simplicity of Arrangement and Reduced Maintenance: Accessibility for all normal maintenance makes it simple, quick, safe and low-cost. Adjustments are easily made while the unit is in operation. Using only clean primary air supplied under pressure, fan maintenance is substantially reduced and fuel piping is greatly simplified. Also, with the pulverizer acting as its own distributor, no special distributing devices are needed. Grinding elements are of special alloy material. They last two years or more on eastern coals and at least a year on midwestern coals.

Adaptable to All Types of Automatic Controls: Because it features "one point contact with the boiler," operation of the B&W Pulverizer is simple. The boiler's automatic combustion control is connected to the pulverizer at only one point—the damper in the primary-air duct. The pulverizer's own control system regulates all other functions, such as maintenance of proper fuel-air ratio and operating temperature.

SEND FOR DATA. For full information about the B&W Type EL Pulverizer and Pulverized-Fuel Firing Systems, write: The Babcock & Wilcox Company, 161 E. 42nd Street, New York 17, N. Y.



COAL RECIRCULATION — this means high fineness, aids drying.

PRESSURE SYSTEM — this eliminates fan wear, simplifies piping.

AIR CONTROL—this means one, simple control contact point.

MILL LEVEL CONTROL — this automatically adjusts fuel-feed.

BABCOCK & WILCOX

BOILER DIVISION

G-766

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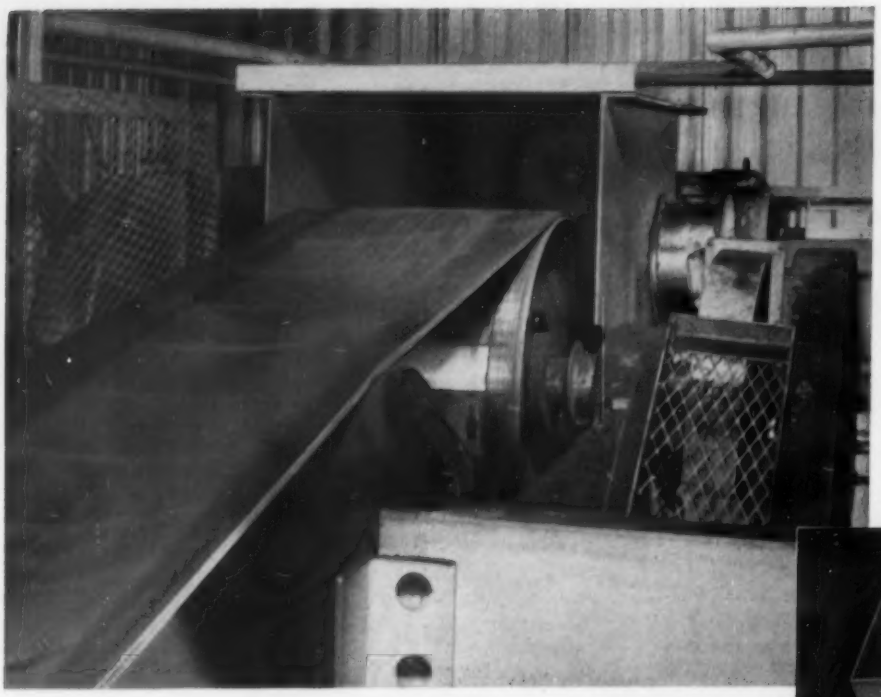


Stearns permanent magnet pulley traps damaging tramp iron as coal for automatic boilers passes into pulverizer at head of 171-ft primary conveyor in coal transfer tower. Small photo shows iron collected in bin during one shift. Rated at 75 tons per hour, conveyor system totals 480 ft in two stages, normally handles up to 300 tons per day depending on coal delivery.

"Tramp iron is no problem,"

says Power Plant Superintendent

STEARNS MAGNETIC PULLEY PROTECTS COSTLY FEEDERS

Protecting costly crushers and feeder mechanisms in the coal-handling system at Milwaukee County Institutions, a Stearns permanent magnet pulley removes dangerous tramp iron before coal is delivered to the automatic boilers. Installed at the conveyor head in the coal transfer tower, the powerful magnetic pulley seizes iron junk in the moving load, deposits it safely in a bin for easy disposal.

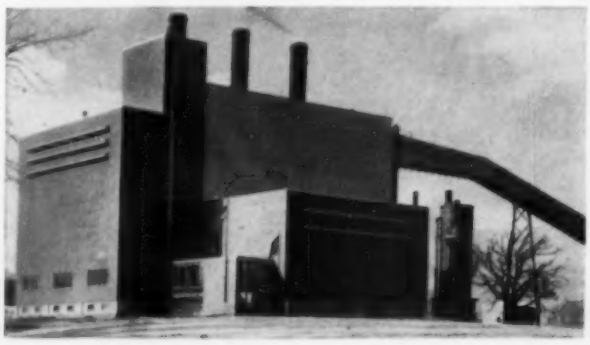
"Tramp iron is no problem in our coal-handling system," says Louis H. Winnard, Power Plant Superintendent. "The Stearns magnetic pulley does a thorough job.

"Before the coal conveying system was completed, we operated for a time without magnetic protection," recalls Mr. Winnard. "There was some difficulty with stray iron jamming in the stoker feeders, but we've had no trouble since then. Effective removal of tramp iron is a built-in feature of the system at Milwaukee County Institutions."

For positive protection from dangerous tramp iron, Stearns builds a complete line of electro and permanent magnet pulleys. Stearns specialists are ready to help you select exactly the right pulley for your system — a powerful, efficient unit *backed by 40 years of magnetic research, design and engineering experience.* Call your Stearns representative today or write for more information about Stearns magnetic pulleys. Ask for Bulletin 350-CM.

30

An outstanding example of modern power engineering, new power plant at Milwaukee County Institutions is designed for automatic operation, minimum supervision. The institutions are located on a 1,200-acre site in western Milwaukee County, Wisconsin, and comprise six medical care institutions of 6,000 beds housed in 80 buildings served by this power plant.



STEARNS MAGNETIC PRODUCTS

635 South 28th Street • Milwaukee 46, Wisconsin

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WHY LET YOUR FUEL DOLLARS GO UP IN SMOKE?

Packaged Ljungstrom® Preheaters increase efficiency for boilers as small as 25,000 lbs per hour! Money spent on fuel in a single year often equals the cost of the boiler itself! And with fuel prices continually rising, every BTU is doubly precious.

So don't let fuel dollars go up the stack—in smoke. Whether your boiler produces 25,000 or 250,000 pounds of steam per hour, the shop-assembled Ljungstrom preheater recovers heat—and dollars. Results: FUEL CONSUMPTION IS REDUCED! Generally 10% or more. This will usually write off the cost of a Ljungstrom in less than 2 years.

BOILER PRODUCTION IS INCREASED! By preheating air, higher temperatures in the furnace are assured, higher heat absorption and steam producing capacity are made possible.

LESS MAINTENANCE NEEDED! Improved combustion means less slag, cleaner stack gases. Thus you benefit from fewer overhauls; longer service between shutdowns.

LOW GRADE FUELS PRACTICAL! Higher furnace temperatures permit effective burning of very low grade fuels.

COMES READY TO INSTALL! The Ljungstrom is shop-assembled, is easily applied to your steam-generating units. For details, contact The Air Preheater Corporation today. Ask for our free brochure.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.

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CONSTRUCTION NEWS

Wilsonville, Ala. — Southern Electric Generating Co has chosen a site near here for proposed $150,000,000 steam-electric power plant. The location was revealed by the company, jointly owned on an equal basis by Georgia Power Co and Alabama Power Co, both subsidiaries of Southern Electric. Company has filed an application with the Alabama Public Service Commission for permission to build the plant.

Los Angeles, Calif. — Southern California Edison Co, 601 W Fifth St, has disposed of a bond issue of $40,000,000, portion of proceeds to be used for extensions, additions and improvements in power plants and systems through 1957, including extensions of power generating facilities, transmission lines, power substations and other work.

Orlando, Fla. — Orlando Utilities Commission has announced plans for the construction of a new steam-electric generating plant, near the Indian River in Brevard County. Plant will have an initial capacity of 75,000 kw and is part of a $22,000,000 expansion program by the company brought about largely by the recent location of the Martin Co plant here. Work on the new unit is already under way and is scheduled for completion in late 1958. Cost of new unit and installation will approximate $10,000,000.

Dresden, Ill. — Commonwealth Edison Co, 72 W Adams St, Chicago, Ill., has authorized construction of the nation's largest nuclear power reactor on 950-acre site selected for the purpose, where the Kankakee and Des Plaines Rivers meet to form the Illinois River. General Electric Co will construct the dual-cycle, boiling water reactor plant at a reported cost of $45,000,000. Company will own and operate the plant when completed in 1960 and will contribute $30,000,000 of the contract price. Dresden Station will have an initial capacity of 180,000 kw and when completed will feed into company's power grid and interconnected transmission systems which serve Chicago and northern Illinois.

Peoria, Ill. — Central Illinois Light Co, 316 S Jefferson Ave, has announced plans for the construction of a new steam-electric power plant on the Illinois River, south of here. Work on the first unit as planned will have an initial capacity of 125,000 kw and is scheduled to be placed in operation in 1960. New unit will be of the latest reheat type and will operate at a steam pressure of 1800 lb per sq in., and a temperature of 1000 degrees. Plant will represent an investment of approximately $62,000,000.

Peru, Ill. — City of Peru has announced plans for the installation of new steam-electric generating unit in municipal power plant, along with additional equipment to double present capacity. Cost for furnishing and installing both the steam generating unit and turbines will cost in excess of $900,000.

Baton Rouge, La. — Gulf States Utilities Co, 362 Liberty Ave, Beaumont, Tex., plans construction of a new 162,000-kw electric generating plant near here, at a cost of some $20,000,000. New power plant will be built around an outdoor turbine generator, the largest ever installed by the company. The 1957 budget of $48,000,000 is the largest in the firm's history and part of a four-year construction program involving an expenditure of some $150,000,000. New plant will be company's fifth power plant and the second east of the Mississippi River.

Holyoke, Mass. — Holyoke Water Power Co, 1 Canal St, has authorized plans for the construction of new steam-electric power plant here. New project to be known as the Smith's Ferry-O'Hares Grove Power Plant will have an initial capacity of 137,500 kw and when completed in 1959 will cost in excess of $30,000,000. Jackson & Moreland, Boston, Mass., engineers of the project.

Newberry, Mich. — Director of State Building Department, Lewis Cass Bldg, Lansing, Mich., has awarded a contract in the amount of $111,280 for the installation of a new turbine generator with auxiliary equipment in Newberry State Hospital. Work is currently under way under the supervision of E. R. Little Associates, engineers on the project.

Independence, Mo. — City Council, City Hall, is arranging financing through the sale of bond issue in the amount of $8,000,000, proceeds to be used in connection with expansion and improvement in municipal power plant, including new generating facilities, power substations, transmission lines and other miscellaneous work.

Lexington, Neb. — Central Nebraska Public Power Irrigation District, 1513 W Second St, Hastings, Neb., has plans under way for construction of new steam-electric generating plant and related facilities near here. A single unit with an initial capacity of 100,000 kw will be installed at a reported cost approximating $17,000,000. Work is already under way and plant is expected to be placed in service by late 1958.

Trenton, N. J. — Public Service Electric & Gas Co, 80 Park Pl, Newark, N. J., has concluded the purchase of a 68-acre tract of land on Duck Island, in the Delaware River to be used as site for proposed steam-electric generating plant, near here. Company has plans under consideration for the construction of a large power generating station to cost approximately $72,000,000. It is understood that this will form part of major company expansion now under way. Details of construction and installation are expected to be announced shortly.

Massena, N. Y. — General Motors Corp, General Motors Bldg, Detroit, Mich., has announced that the State Power Authority of New York has approved unanimously, company request for 12,000 kw of St. Lawrence power production. General Motors has approved plans for the construction of a $15,000,000 foundry immediately adjacent to the new aluminum production plant of Reynolds Metals Co, for the casting of aluminum transmission parts and pistons for its Chevrolet line. Foundry when completed in early 1959, will employ about 700 persons.

Mineola, New York — Long Island Lighting Co, 250 Old County Road, has announced plans for the expenditure of more than $500,000,000 in major expansion and improvement program of company's generating and distribution system over the next ten-year period. Planned construction will run at a slightly higher average above what the company has experienced over the last five-year period. From 1952 to 1956, the utility has spent an average of $47,400,000 annually. The 1957 construction budget, however, will run slightly higher at an estimated $50,000,000, from $46,909,000 spent in 1956.

Rochester, N. Y. — Rochester Gas & Electric Co, has arranged financing through sale of bond issue to total about $15,000,000, majority of proceeds to be used for 1957 expansion and improvement program, including generating facilities, power substations, transmission lines and other corporate improvements.

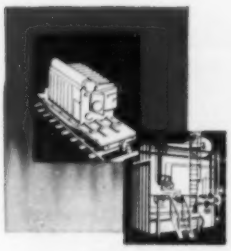
Charlotte, N. C. — Duke Power Co, 422 S Church St, has plans under consideration for the construction of a new hydroelectric project on the Catawba and Wateree Rivers in the Carolinas. Company has recently requested that the FPC grant a license for the $50,900,000 development to be known as the Cowan's Ford Power project. Proposed development will have an ultimate generating capacity of 35,000 kw. Major item in the project will be the construction of a 5870-ft concrete and earth fill dam backing up a 29,760-acre reservoir.

Waltz Mill, Penna. — Westinghouse Electric Corp, Atomic Power Division, Pittsburgh, Penna., has authorized plans for the construction of the first industry owned nuclear materials testing reactor on local site here. The multi-million-dollar full scale testing reactor will operate in the range of 20,000 kw and will be used to test materials under conditions similar to those in a power reactor. Ground has already been broken and work is under way for scheduled completion late in 1958.

El Paso, Tex. — El Paso Electric Co, 213 N Stanton St, has arranged for bond and stock issue of $8,500,000, proceeds to be used in connection with 1957 expansion and development program of company's generating facilities, power substations, transmission and distribution lines and other miscellaneous work.

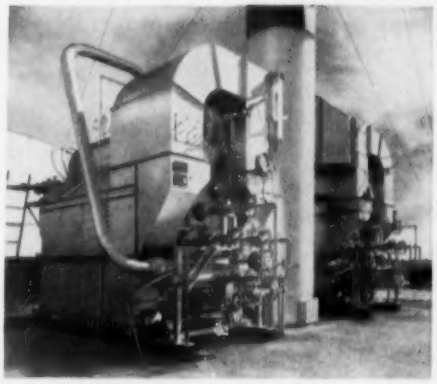
Eau Claire, Wis. — Northern States Power Co, 4 S Barstow St, has entered a registration statement with the SEC for the sale of a bond issue in the amount of $10,000,000, proceeds of which will be used to pay off short term bank loans and construction expenditures to cover cost of increased generating facilities, power substations, transmission lines and other work.

Rhinelander, Wis. — Rhinelander Paper Co has authorized new steam-electric generating plant and buildings, for which plans will be prepared at once. Installation will include turbine-generator, high pressure boiler and auxiliary equipment for large capacity. Installation reported to cost in excess of $535,000, will be supervised by Pfeifer & Schultz, Minneapolis, Minn., consulting engineers.



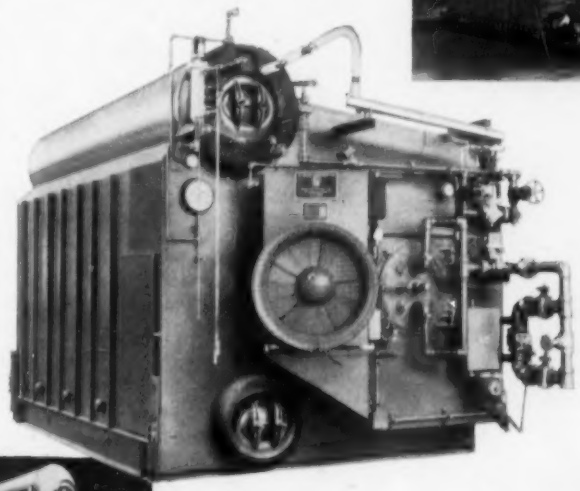
HEAT ENGINEERING by FW

extends Central Station Reliability to Standard INDUSTRIAL and PACKAGED UNITS



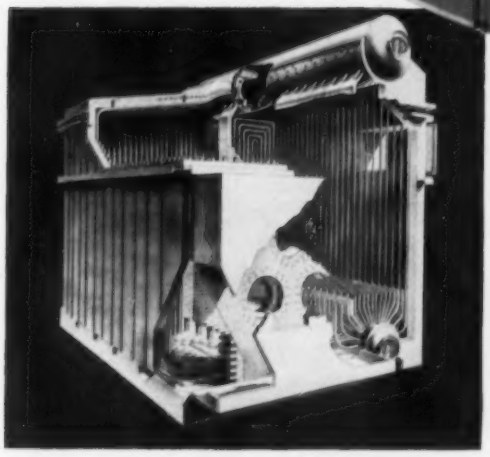
Above: Two FW packaged boilers — the first ever offered to industry — were installed for oil field drilling operations in 1940. They are still in service, delivering low-cost steam.

PACKAGED STEAM GENERATORS of the water-tube type were introduced by Foster Wheeler in 1940 — combining in a single, compact, shop-assembled unit, all the necessary facilities for the dependable and economical generation of industrial steam. Continual research and development have resulted in further improvements in design and construction, and today the FW line of Packaged Steam Generators, in capacities from 10,000 to 60,000 lb/hr, represents the last word in modern steam plant design, reflecting over half a century of service to the power generation industry. Features include 36″ steam drum and 24″ water drum, staggered boiler tubes, closely spaced waterwall tubes, water-cooled target wall, and wide choice of burners and controls.



Left: New Foster Wheeler series AG-100 Packaged Steam Generator.

Cutaway view of typical FW Standard Steam Generator.



STANDARD PRE-ENGINEERED UNITS by Foster Wheeler offer all the advantages and economies of *standardization* for larger industrial steam generators of from 50,000 lb/hr to 450,000 lb/hr capacity. The new FW line of "SC" and "SD" standard units is heat engineered to the same standards of dependability and performance which have made Foster Wheeler steam generators first choice in many of the leading central station plants throughout the country. Features include completely water cooled walls, efficient firing arrangement, fully drainable superheater, high steam purity, unrestricted circulation, pressure-tight construction and minimum refractory baffling. For further details, send for Bulletin B-55-4.

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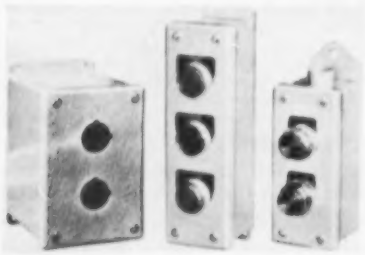
For more data circle 529 on Post Card

EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 115–116 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

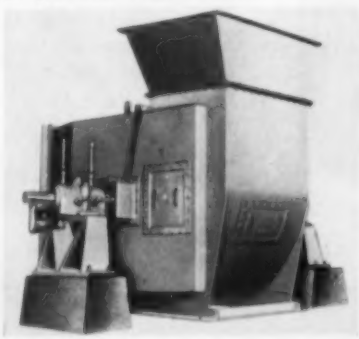
1—PUSHBUTTON ENCLOSURES come in some new shapes

Extra deep, slim and pendent oil tight pushbutton enclosures made of steel are recent additions to this manufacturer's line of standard 3-in. deep, oil tight pushbutton boxes. They are designed to receive any regular make of oil tight pushbutton control unit. The extra deep enclosure (left in photo) is 4¾ in. deep and provides the greater space needed for wiring stacked or tandem oil tight pushbutton units. Ten standard sizes accommodate 1 to 25 pushbuttons. The slim enclosure (middle) is 2½ in. square and can be mounted vertically or horizontally. Standard sizes hold 1 to 10 units. The pendent model is 2½ in. square and has a conduit hub. Standard sizes hold up to eight units. All types have gasketed covers and external mounting feet. Cover screws are captivated and thread into sealed wells. Standard finish is gray hammertone enamel. Hoffman Engineering Corp.



2—INDUCED DRAFT FAN with low tip speed characteristic

Type DN Dynacurve Fan features an all welded fan wheel, with 36 aerodynamically curved blades whose unique shape results in a low tip speed characteristic. Because of the fan wheel and housing design, floor space and height requirements are minimized, company states, while high efficiency is maintained. The fans are built in standard tip speed designs ranging to 14,000 fpm, and all sizes operate at sufficiently high speeds that they may be direct driven by standard moderate speed motors. Other distinguishing features claimed are sturdy construction, high efficiency over a wide performance range, and a broad static pressure volume. Catalog 905 gives data. Clarage Fan Co.



3—VERTICAL HEATER for heating at high temperature

The Hi-Turbiant Heater offers a means of heating Dowtherm, Aroclor, hydrocarbon oils and other heat-sensitive fluids, manufacturer announces, and is also suited for steam superheating and processes where fluids must be heated under close thermal control. This heater consists essentially of a series of "hairpin" tubes set vertically in a low conductivity refractory setting. Each radiant tube is exposed to uniform absorption in the cylindrical combustion chamber. A cross-flow integrally mounted finned tube convect on section is used for high thermal efficiency.

Forced circulation is provided by high temperature centrifugal pumps. According to manufacturer, the designed high fluid turbulence permits high fuel efficiencies at maximum operating temperatures for heat sensitive media, it is pointed out, and the extended surface crossflow convection section is used where maximum thermal efficiency is required or when a second stream requires moderate heating. Burners are available for many fuel requirements. The Hi-Turbiant Heater is available in sizes from 3- to 40 million Btu/hr — with or without convection section. Western Precipitation Corp.

4—SILICON REPLACEMENTS for vacuum tube rectifiers

Tube base mounted silicon replacements for vacuum tube rectifiers, which provide saving on filament power supply, cooler operation, long life and resistance to vibration and shock, are announced. The S6X4, a direct replacement for the 6X4 full-wave high vacuum rectifier tube, features an output of 85 ma d-c maximum, an input voltage of 400 v rms, and a maximum peak current of 225 ma. Maximum PIV is 1250 v; voltage drop is 6 v at 70 ma. Physical dimensions approximate the same overall dimensions as those of the standard 6X4 tube, will plug into same tube pockets. International Rectifier Corp.

5—REDUCING VALVE, pilot operated, for steam service

An improved version of this company's pilot operated reducing valves for steam service, the Type 92B is a self-operated unit, obtaining pilot operating medium directly from the inlet. This feature is reported to make the valve desirable for applications where air or gas as an operating medium is not available or where its use is not practical. The Type 92B is designed to minimize certain problems inherent in steam regulation, such as clugged orifices, sticky valves and diaphragm rupture. The Fisher Governor Co.

6—EMERGENCY KIT repairs tanks, pipes, pumps, valves

Based on the use of Plastic Steel, this repair kit is offered for on-the-spot repairs of equipment and machinery. Plastic Steel, a combination of 80 per cent steel and 20 per cent plastic, can be formed into any shape and will not run or sag when applied to a vertical service, manufacturer states, and 2 hr

after application it becomes a strong, tough, rigid metallic piece. Heat or pressure are not required. It is claimed durable, permanent, essentially nonshrinking or expanding. Plastic Steel does not depend on evaporation for hardening and will even harden under water, it is announced.

While Plastic Steel is strong enough by itself for most repairs, the kit includes treated glass tape for use as a "bandage" if large holes or corroded areas are present. Laminations of the tape and Plastic Tape are reported to have a compression strength of over 50,000 psi, a tensile strength of over 45,000 psi. Each kit contains 1 lb of Plastic Steel, a jar of hardening agent, a jar of release agent, rubber-covered steel patch, glass tape, measuring spoons and directions for use. It costs around $3.25. Devcon Corp.

7—OVERLOAD CONTROL is electro-mechanical device

Reported unusual in its combination of accuracy, continual indication of motor load, and adjustable load limits, the Load Sentry is designed for use wherever overload of any kind may be registered on an electric motor. An electro-mechanical control, it is built around the positive action of a contact meter-relay and has no electron tubes. It is readily hooked into "start-stop" switches. Maximum load to be permitted on the motor being monitored is set by an adjustable pointer on the dial of the meter-relay. This dial has 30 divisions from 0 to 150 per cent of normal load. Another pointer indicates actual running load

Another Case of Cost-Saving with Crane Steel Valves

This valve has a 28-year service record

Here is another prime example of Crane valve dependability—and what it means in dollars and cents to the user.

This Crane cast steel wedge gate valve has seen more than 28 years of service. It is installed in a line from the steam header in the plant of Scott Paper Company's West Coast Division, Everett, Wash. The 8-inch, 300-pound valve is operated 2 or 3 times a week. After almost 3 decades of hard, continuous service on 450°F. steam at 250 psi., this rugged, precision-built Crane valve still closes tightly and easily. Yet it has required only routine maintenance.

From the outside, Crane valves may resemble others. The big difference is on the inside—where Crane quality in design and construction, in precision machining and superior castings, assures the low-cost, trouble-free operation you want. Call your Crane Representative for expert assistance in specifying and ordering.

You may spot cost-saving ideas in this book of "Valve Performance Facts"—32 case histories throughout industry. Ask your Crane Representative or write for a copy.

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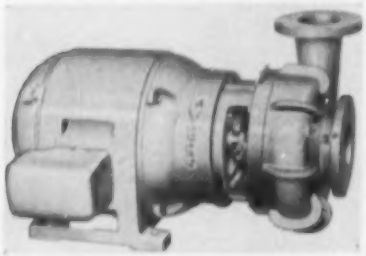
on the motor. When the pointers meet at an overload position, contacts lock and the circuit is broken, company explains; the Load Sentry will then sound an alarm and/or shut down the system.

Safety features of the Load Sentry include an interlock that keeps the circuit broken after an overload until the cause of trouble has been corrected and a manual reset button pressed to restart the motor. Another feature announced is "fail-safe" circuitry. The load relay is energized when the control is operating, in contrast to the customary unenergized condition. Overload causes the relay to drop out and break the circuit through the motor. Other abnormal conditions will also short out the load relay. Assembly Products, Inc.

8—CENTRIFUGAL PUMPS for heavy-duty industrial uses

The Hi-Capacity Hi-Head series of centrifugal pumps is suggested for conditions requiring high gallonage and pressure. Designed to meet a variety of industrial requirements, the pumps come



in three sizes and are available as motor-mounted, direct-connected, or belt-driven units, all standard bronze fitted. Sizes include the 300 series (3 by 4 in.), the 400 series (4 by 5 in.) and the 500 series (5 by 6 in.). The 3 by 4-in. size operates at 3,450 rpm; the 4 by 5-in. and the 5 by 6-in. sizes operate at 1,750 rpm. Capacities range from 200 to 1,500 gpm at heads to 340 ft., and horsepower ranges from 15 up to 60. Pumps are available with conventional stuffing box or with mechanical seals. The F. E. Myers & Bro. Co.

9—BOILER SCAFFOLD is readily installed and moved

For use in boiler maintenance, this scaffold gives complete coverage of the boiler for construction or repair, says manufacturer, and it allows for communication between the man in the boiler and the outside operator. It is accessible by workmen, and material may be hoisted inside the boiler. According to manufacturer, this scaffold may be rapidly removed and dismantled, is easily stored, and is self cleaning. Atlas Industrial Corp.

10—CIRCUIT BREAKER combines two breakers in one case

Type TR is announced as a twin plug-in circuit breaker which makes it possible to install up to twice the number of circuits normally possible in an average load center. Introduced at the same time is a line of circuit breaker load centers in main ratings from 40 to 200 amp, and from two to 40 branch circuits. According to company, Type TR combines two breakers in a single 1-in. case. It is physically interchangeable with company's single-pole Type R breaker and 2- and 3-pole common-trip Type TQL breakers. Available in ratings of 15 and 20 amp, the breaker is suitable for use in protecting a-c lighting and appliance branch circuits. Handle extensions are available for combining two adjacent breakers for two-pole operation. The twin circuit breaker has a 5000-amp interrupting capacity. General Electric Co.

11—PILOT VALVE converts cylinder to power positioner

This remote mounted positioner is reported low in cost and designed to convert any high grade commercial cylinder to a double-acting power positioner. It converts input air signals to pneumatic or hydraulic signals up to 150 psig for actuating power pistons, diaphragm motors and rotary vanes. Standard input signal range is 0 to 30 psig. Manufacturer says the compact positioner is particularly adaptable for use with power pistons since it lets user choose the most desirable power cylinder from the standpoint of bore, stroke and style of mounting. A conventional application noted is the positioning of large butterfly valves in response to signals from a remote control point. The air signal acts on a diaphragm in the positioner, displacing the small servo valve and sending air or hydraulic pressure to either end of the power cylinder. This, in turn, actuates the butterfly valve. Hagan Chemicals and Controls, Inc.

12—TIMING RELAY can fit into limited space

This smaller, more compact pneumatic timing relay is designed to meet restricted space requirements. The narrow-base relay measures only 2½ in. wide by 7⅝ in. high. It is announced as offering an adjustable timing range of 0.2 sec to 3 min with an accuracy of plus-or minus 10 per cent. The device can be converted from on-delay to off-delay operation — or the reverse — in the field without special tools. The a-c version, designated as Class 9050, Type B, may be used on circuits up to 600 v. One or two double-circuit, instantaneous interlocks can be supplied with the Type B or added later at the job. A d-c model with the same characteristics is also available. Square D Co.

13—ROOF VENTILATOR with airfoil type fan

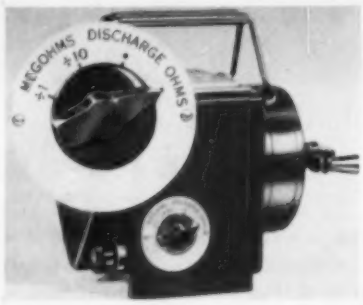
Wingjet Power Roof Ventilator has a powerful airfoil type fan mounted in a weatherproof fan casing, it is announced and covering this are non-chattering, aluminum dampers which are opened immediately by airstream and held open as long as fan is operating. An upper casing or windshield surrounds and protects the dampers and is open at top, without hood or raincap, for free, direct, maximum exhaust. The jet of air is carried at high velocity far above the roof to prevent vitiated air from damaging roof surfaces, or re-entering building through fresh air intakes or windows. While fan is running, rain or snow cannot enter, company states, and when it is not operating, dampers close to form a weather-tight closure. Two types of Wingjet are available: Type B, for exhausting hot, corrosive or fume-laden air, with motor located out of the airstream, in a weatherproof housing, driving the fan by means of a V-belt; and Type C, for exhausting uncontaminated air, with motor in the airstream, directly connected to the fan wheel. L. J. Wing Mfg. Co.

14—SHREDDED METAL PACKINGS available in two types

Styles 934 and 935 are intended for use under high steam pressures and temperatures. Both packings are of copper tinsel, treated with rubber cements, graphited throughout, molded to shape and cut open with a beveled joint. Style 934 is offered in ring form only, usually molded to a square cross section and bevel cut, while Style 935 is a packing set consisting of conical shaped molded center rings with 120-deg included angle and bronzé top and bottom adapters. Other metal adapters are available. Both styles are recommended against steam, air, water or gases (except ammonia) on valve stems, reciprocating rods, and rotary shafts of pumps, blowers, turbines, compressors. Manufacturer recommends these packings for temperatures to 1500 F, with pressure range dependent on application. The Garlock Packing Co.

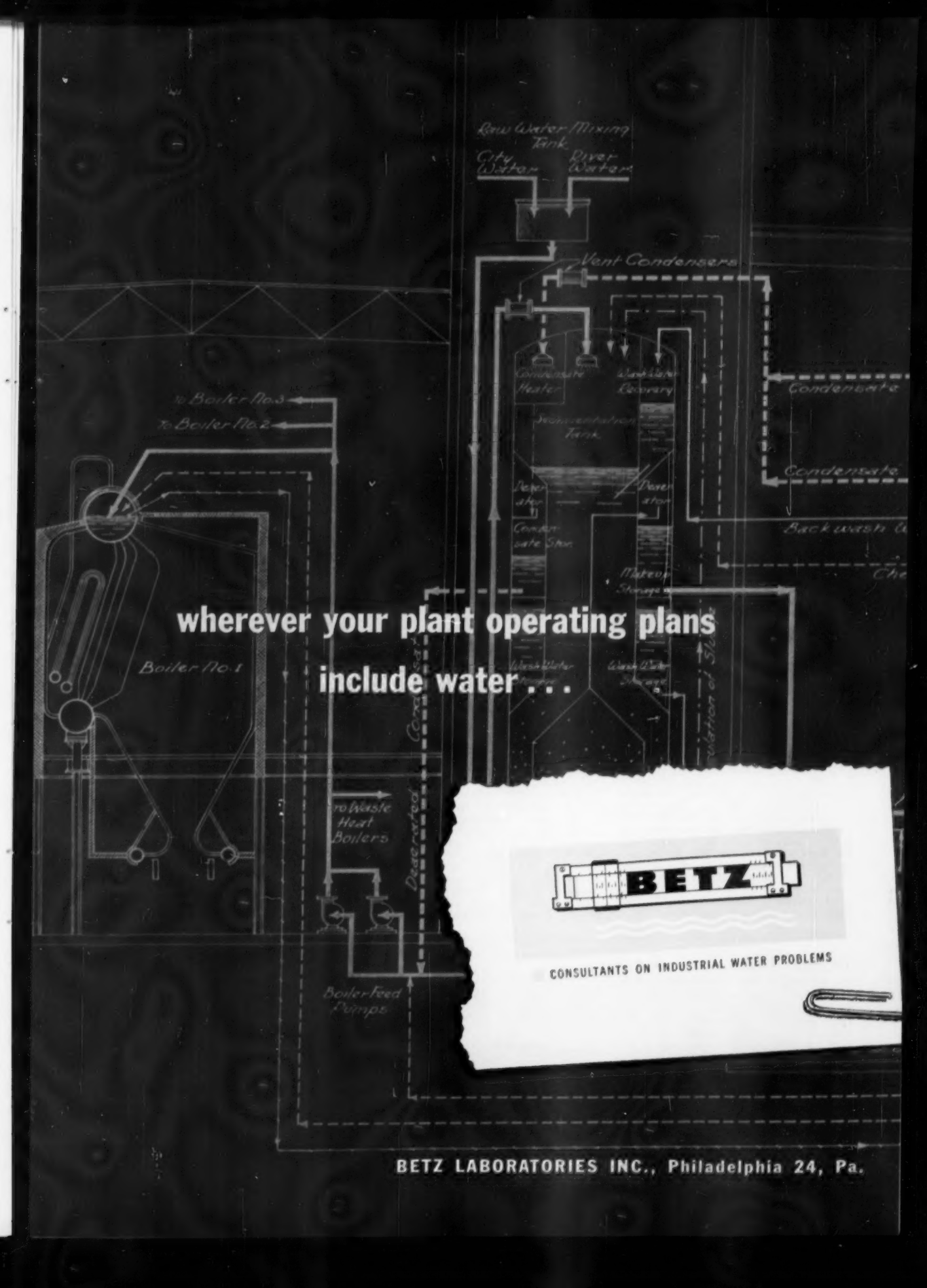
15—INSULATION TESTER with four-position switch

Recently introduced on the Meg Type Megger Insulation Tester is a four-position switch. The hand-operated generator models now provide facilities not formerly available in one instrument, says manufacturer. The A-R-K Switch includes: (A) megohms ÷ x 1 and ÷ x 10; (R) ohm scale; and (K) capacitance discharge switch. In addition



there are earth, line and guard terminals arranged to require no change of connections when switching to ohm scale.

The ratio switch (A) divides by 10 the regular megohm scale. Thus an instrument having a normal range of 0 to 1000 megohms also has, with the ratio switch, a range of 0 to 100 megohms, permitting insulation resistance measurements down as low as 10,000 ohms. The discharge switch (K) permits discharge of capacitance in the apparatus under test. This charge is built up during the test because the test voltage is d-c. The ohm scale (R switch) has a range from 0 to 10,000 ohms. With it tests can be made of conductor resistance without resorting to other test equipment. The ohm scale is used in addition to and independently of the Megohm scale. It is pointed out that this facility for discharging capacitance removes hazard to persons and equip-



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CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

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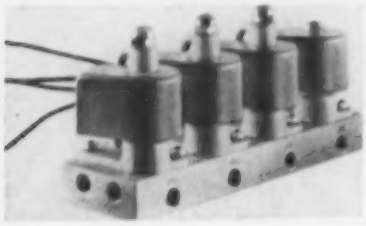
ment that might come in contact with charged apparatus following the test. Bulletin 21-45a gives particulars on the instrument. James G. Biddle Co.

16—SOLENOID VALVES designed for manifold mounting

These midget two- and three-way solenoid valves, for manifold mounting, are offered to meet the demand for grouping a number of solenoid valves on a common body, eliminating separate pipe connections to each valve. Any combina-



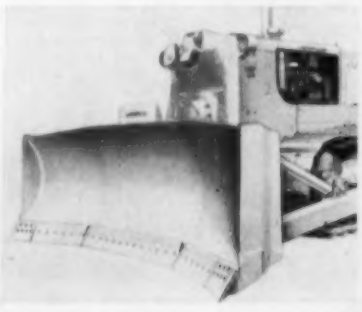
tion of two- and three-way valves may be used when operated from a common pressure and return line. Valve solenoids may be controlled individually or in any combination, depending upon service requirements. They have stainless steel cores and soft composition discs for tight closure. Each valve can be quickly removed from manifold body, company says, without disturbing other valves or pipe connections. Valves are suitable for handling air, gas, water, light oil, refrigerants, etc. up to a maximum temperature of 212 F. Pressure range is 0 to 300 psi. The three way valves may be changed from normally closed to normally open operation by revolving valve body 180 deg. Bulletin 8351 gives details. Automatic Switch Co.

17—LINED PUMPS for sand and slurry handling jobs

Model 600 is a heavy duty sand and slurry pump equipped with wear-resistant liners, replaceable and interchangeable with either hard metal or rubber. This flexibility makes the pump suitable for any slurry pumping problem, says manufacturer, or allows it to accommodate changes in operating conditions. The pumps are built for sand, slurries, or gritty water on flotation processes, cyclone feed, refuse or tailings disposal, ash handling, coal handling in washers and pipelines and similar applications. They range in sizes from 2 to 8 in., capacities from 20 to 2000 gpm, up to heads of 100 ft. Bulletin 601 gives details. Krogh Pump & Equipment Co.

18—BULLDOZER designed for handling the tough materials

For coal handling and other jobs, the 9U Bulldozer's design allows it to retain large loads on long-distance moves, it is announced. It has a straight center section and two side sections angled forward. The latter cast material inward, and the straight center section pushes the material ahead of the blade to provide for a minimum of end spillage. Rugged strength with minimum weight for handling tough materials is attributed to the box-type construction of the bulldozer. The unit is 14 ft, 10 in. wide, overall. Caterpillar Tractor Co.



19—SWITCHBOARD built in standardized modules

The Type DR Universal switchboard is designed for incoming service, 600 v or less and its mains are rated 800 through 4000 amp. Structure and vertical bus bars are drilled to accommodate virtually any combination of seven different low voltage protective devices. These are divided into three classes: circuit breakers — both molded-case breakers and large AK air circuit breakers; circuit breaker, current-limiting fuse combinations, either standard breaker with current limiting fuses or the current-limiting, molded-case breaker with integrally mounted current-limiting fuses; and fused interrupter switches. The latter group includes company's new Type QMR, interrupter switch, a non-automatic breaker with series fuses, and company's Type LB-1 service protector, a combination high-capacity switch with current-limiting for service entrance and feeder applications.

This switchboard is pre-engineered to predetermined standards and constructed in unitized modules — making it possible to lay out, price and dimension this switchboard from published information. It also allows protective devices to be added, replaced or rearranged in the field with minimum labor. Also it enables ordering and installing of additional sections in the field with assurance that they will line up with earlier installations. Mains of this switchboard consist of bus bars mounted horizontally in center of each section. Separate vertical bus structures in each section are center fed from main bus, leaving top and bottom areas of the section free for incoming cable or busway. General Electric Co.

20—THROTTLING VALVES for variety of installations

Among advantages reported for this series of precision throttling valves are low torque, precision control, high efficiency and long life, self-aligning seat, and a variety of port sizes accomplished with only two basic body configurations. The valves are designed to permit interchangeability of angle and through-type body configurations. Valve body may be removed and valve seat replacement may be accomplished without breaking the line, says manufacturer. Available with female pipe thread, female brazed tube fitting and JIC threaded parts, these valves are offered for use with oils, fuels and other liquids compatible with aluminum and steel. They can also be provided in other materials for service applications, such as water, corrosive liquids. Greer Hydraulics, Inc.

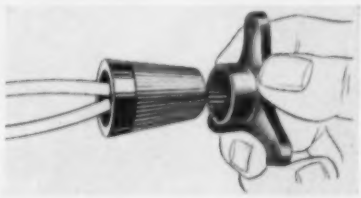
Reader Service Cards on pages 115–116 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

21—LIFT CHECK VALVE is made of rigid PVC

Body and components of this lift check valve are made of normal impact rigid polyvinyl chloride to provide high corrosion resistance to alkalis, acids, inorganic salts and other corrosive flows. A PVC spring positions the disk for quick shut-off. The valve is designed to operate at pressures to 150 psi at 75 F. It is available for pipe from ½ through 2 in. in size, and comes in threaded, solvent-weld socket-type or flanged ends. Walworth Co.

22—IMPROVED WRENCH for tightening wire connector joints

With the Lok-It, you can make "screw-on" wire connector joints so tight you cannot unscrew them with your bare fingers, it is announced. This wrench fits



two sizes of company's Bakelite wire connectors (standard and large construction sizes), available for general use in branch circuit wiring. The Lok-It is grooved to match the connector knurling. As the illustration shows, you simply slip the wire connector into the wrench socket — your fingers needn't touch the connector to slip it into the wrench. The new wrench has built-in gages for solid wires, Sizes 10, 12 and 14. It is offered without extra charge in an introductory package containing both sizes of the Bakelite wire connectors. Holub Industries, Inc.

23—METERING DEVICE records, indicates, controls

Engineering features incorporated in the redesigned Hagan Ring Balance Meter include: enclosed measuring system in which working parts do not contact measured fluid; quantity and density of sealing fluid not critical; dead weight checking without disconnecting meter piping, either at atmospheric or full static pressure; ring torque at minimum full scale differential ten times the power required. The series of measuring elements for full scale range from 0.5 in. WC at 5 psig to 560 in. WC at 6000 psig, or 140 in. WC at 15,000 psig, are available. Stuffing boxes and pressure tight bearings are omitted.

Actuating element of the meter is a hollow ring fitted with a baffle in the top and partly filled with a heavy fluid. Differential pressures, admitted through

Sensing level change at a remote point, these Leslie Floatless Level Pilots (left) operate heater drain level control valves (right). Pilots are on ground floor, heaters and Leslie diaphragm control valves are on second floor of this Midwest power station.

differential pressure method offers

STABLE, FASTER-SENSING LEVEL CONTROL

Because the Leslie Level Control Pilot uses the differential method for sensing changes in liquid level, it receives its impulse changes faster than any other type of level control. You can install it *anywhere* below liquid level, mounted on the valve, or at a point remote from vessel or valve. Used on either open or pressurized vessels, it controls the liquid level in such applications as condenser hotwells, deaerators, heater drains as shown above and storage tanks.

And It's Floatless, too!

There are no floats, torque tubes, seals, stuffing boxes or thermal-hydraulic tubes which are affected by turbulence, wear or temperature changes. Installation is fast and uncomplicated. Simple spring adjustment changes set point. Maintenance free, rugged "high impact" design is unaffected by shock. The only *one* moving element is virtually frictionless . . . its total movement is only .006".

Responds Fast . . .

A high air loading capacity in the Leslie Control Pilot means a fast response with a smooth, throttling action free from hunting or cycling.

More Information

Ask your Leslie engineer to give you the complete story of the exclusive features that make Leslie Control Pilots ideal for level control problems. He's listed in your classified telephone directory under "valves" or "regulators".

Send for the engineering data bulletin No. 5303.

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 301 GRANT AVENUE, LYNDHURST, NEW JERSEY

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TROUBLED
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OIL VAPOR
DIRT or SCUM
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AIR LINES?
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AUTOMATIC
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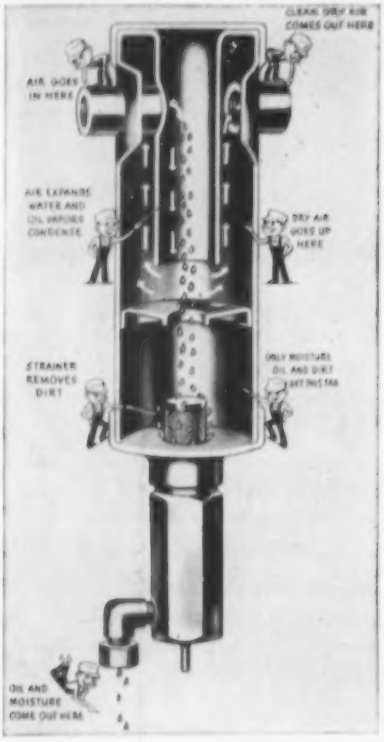
CLEAN DRY AIR COMES OUT HERE
AIR GOES IN HERE
AIR EXPANDS WATER AND OIL VAPORS CONDENSE
DRY AIR GOES UP HERE
STRAINER REMOVES DIRT
ONLY MOISTURE OIL AND DIRT GET INSIDE
OIL AND MOISTURE COME OUT HERE

Dexter AUTOMATIC AIR SEPARATORS are available for air line sizes ⅛" to 10", for point-of-use and main line all-welded construction; no cartridges or filters; 98% efficient.

Another Dexter Preventative Maintenance Product
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THE LEAVITT MACHINE CO.
ORANGE, MASSACHUSETTS

For more data circle 533 on Post Card

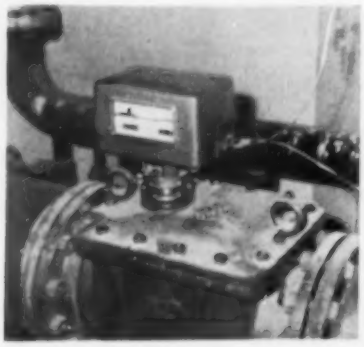
flexible S tubes to the ring on opposite sides of the baffle, give the ring a tendency to rotate around its axis and actuate the pen mechanism. The S tubes eliminate static pressure effect, manufacturer explains and the high ratio of ring torque to friction in the knife-edge bearings result in a sensitivity of 1 in 1000. The meter is used for recording, indicating and controlling process variables involving differential deads, flow, absolute pressures to 20 psia, liquid specific gravity. Instrument accuracy is given as ± 0.5 per cent of full scale range down to 10 per cent of scale. Hagan Chemical & Controls, Inc.

24—CHECK VALVE improves fluid system characteristics

Where line surges and drop-back present a problem in fluid systems, performance can be improved by these check valves, says manufacturer. Spring-actuated, the internal disk closes as flow ceases and does not depend on reverse flow for shutoff. According to company, this eliminates damaging surges of fluids, back-drop, and false registry on meters, as well as the need for anti-hammer devices. Easy installation and low maintenance reported for these valves are attributed to such design features as bearing guides on both sides of the disk and a full flow area that exceeds the pipe area. The valve is designed to operate in any position. Standard sizes are from 2 to 18 in. Pressures range to 2500 psi. Combination Pump Valve Co.

25—BTU METER is completely mechanical instrument

The Pollux Btu Meter measures heat in thermal units and liquid flow in gallons. It is designed to measure heat absorbed by a liquid and heat removed from a liquid, as well as heating and cooling consumed in individual areas. Applications announced include metering of central heating and refrigeration plants, particularly measuring the quantity of



heating and cooling consumed in individual areas of all types of building. It is also adaptable for use with liquids encountered in many industrial and chemical processes.

The instrument consists of a liquid meter and an integrator. The former measures the flow of liquid. The integrator combines the difference between supply and return liquid temperatures and flow through the liquid meter giving a resultant product in Btu's automatically totalized on the counter. The total number of gallons is recorded on a second counter. Directly above the two counters is a pointer indicating instantaneous temperature difference of the supply and return liquid in degrees Fahrenheit. Where required, the meter can be provided with a remote counter for recording Btu's. Air Conditioning Equipment Corp.

26—DIAPHRAGM PUMP for metering and proportioning fluids

This diaphragm pump, for metering and proportioning fluids, is said to perform with accuracy and minimum maintenance at pressures up to 2500 psi. The

diaphragm consists of solid Teflon permanently bonded to, and covering, the face of an elastomeric backing. This type of construction is designed for long diaphragm life by combining the chemical resistance of Teflon with the flexibility of an elastomeric backing. Pump incorporates features such as packless design, capsulated construction, minimum maintenance and smooth, continuous flow in a wide output range. Hills-McCanna Co.

27—THROTTLING VALVE features low turning torque

Of simple construction, the Throttle-Flo is designed for pressures to 5000 psi; it is built in the 1-in. (-16) size. You adjust only a small needle valve to obtain proper flow with it. While needle valves are not always desirable for pressures of 3000 psi and higher because of restricted flow, low high pressure drop and high handle turning torque, this valve is said to overcome such disadvantages by means of pilot needle valve control of a large dynamically balanced piston. Flow regulation is through the pilot valve, which can be turned with the fingers because of the small area under pressure and the large fine-pitch thread. Full flow is obtained by 2½ turns of the pilot valve, it is pointed out, yet metering is accurate to 1/100 gpm through the range of the valve. Catalog Section 155-16D gives further data on it. Republic Mfg. Co.

28—LUBRICANT offers long service, easy application

Custom Lube 101L is announced for the lifetime lubrication of instruments, meters and precision machinery. Manufacturer says this lubricant has a life free from gum or oxidation of 15 years and will prevent wear under extreme loads. The residual oil film from a spray, dip or brushing is claimed sufficient for lifetime lubrication. Properties an-

nounced include a flash point (Cleveland open cup) of 360 F, pour point of −25 F, and no odor from room temperature to 212 F. Bulletin 8A, giving data, and a sample are offered. Vaughn Chemical Co.

29—SAFETY VALVES for set pressures to 300 lb, 450 F

The 1875 series of super capacity top-guided, bronze pop safety valves is introduced for steam generator service and air or gas applications at set pressures to 300 lb at 450 F. Announced

as ASME approved for power boiler and unfired pressure vessel codes, the series is designed to offer minimum inlet pipe size with maximum pressure capacity and low cost. Extra-long top guiding is utilized to give safe, positive protection. The line includes three styles: with plain cap, with open lever, and with packed cap and lever. Sizes range from ½ to 3 in. male inlet, female side outlet. Farris Engineering Corp.

30—ELECTRICAL TAPE can jacket as well as insulate

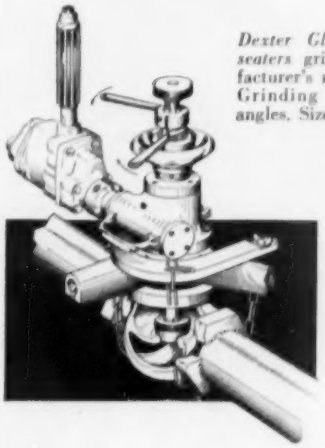
Okoweld is introduced for splicing and terminating either plastic or rubber cables. For connections operating under 2000 v it serves as both insulation and sheath, says manufacturer, no other tape being required. This "two-tapes-in-one" feature is possible because Okoweld, while possessing optimum electrical characteristics, is also resistant to weather, chemicals, flames, and mechanical abuse, it is explained; it can jacket as well as insulate. Upon application, this tape rapidly fuses into a solid homogenous wall around the connection, company states; no adhesives are involved. Okoweld is announced as UL listed and approved for use as "sole insulation and covering of joints and splices in electrical conductors". It comes in five colors for coding purposes. The Okonite Co.

GRIND new, precision VALVE SEATS in-the-line in a matter of minutes with POWER!

Section removed from valve reveals grinding head seated snugly against valve seat. Universal joint permits uniform grinding at any angle.

Reseating a six inch gate valve. Reseaters can be attached to overhead valves or valves in vertical position. Grinding heads for all sizes. Sizes 1" thru 12".

The new DEXTER In-The-Line Gate and Globe VALVE RESEATERS do not cut new seats, but *GRIND* them; a new seat can be applied to any modern valve *regardless of material hardness* in a fraction of the time required by any other method we know of. Rapid reseating of high quality, hard seated valves in-the-line saves you hours of lost production time, high labor rates and the cost of maintaining a large valve inventory. Valve reseating tools should be used at the earliest suspicion of a leak in a valve. We will be glad to have our representative call to show our 16mm movie or for complete information write to Leavitt Machine Co., Orange, Mass., Valve Reseater Division.



Dexter Globe Valve Reseaters grind from manufacturer's reference points. Grinding heads for all angles. Sizes ¼" thru 12".

Gate Reseater with complete set of grinding attachments is stored in compact, easy to carry metal box.

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VALVE RESEATING TOOLS . . STEAM TRAPS . . AUTOMATIC AIR SEPARATORS

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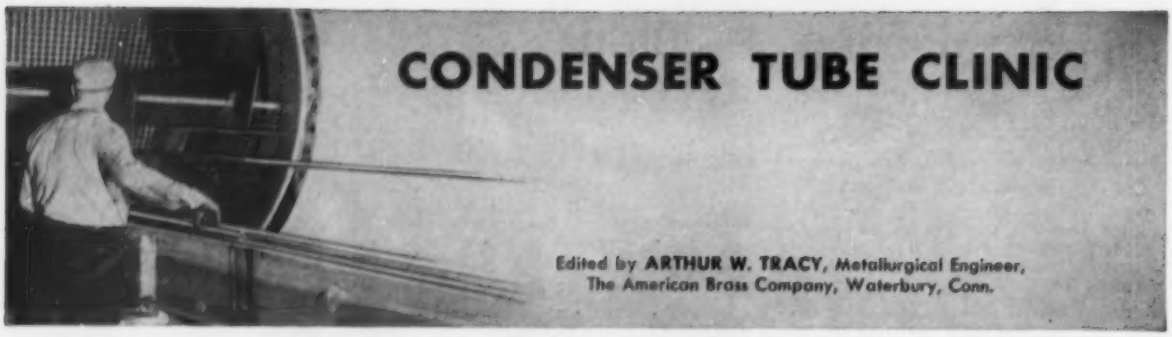

CONDENSER TUBE CLINIC

Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Some operating factors that affect tube life

COMPOSITION OF THE COOLING WATER

The quantities of cooling water used in condensers preclude any treatment to make the water less corrosive, except where the water is recirculated. Economics often does not permit locating a power plant at a site where water is not corrosive.

In general, however, plants located inland will have relatively noncorrosive cooling water. Plants situated on tidewater will have corrosion problems, especially if the water is polluted with industrial or domestic sewage and conditions are such that organic matter in the sewage can ferment under anaerobic conditions, with the consequent formation of sulfides. Water in an enclosed harbor or dead-end channel, where the water is more or less stagnant, is particularly subject to infestation by anaerobic bacteria.

PREVENTIVE MAINTENANCE

Frequent cleaning of tubes to remove slimes containing bacteria and the simultaneous removal of sulfide scales will increase tube life. Chlorination of polluted water at frequent intervals, or periodically filling the water spaces in the condenser with chlorine gas, will not only remove the slimes but may also aid in breaking down the unwanted sulfide films which have formed on the inner walls of the tubes.

In some cases, it may be possible to dredge the channel bottom near the water intake to remove accumulations of decaying vegetable matter.

An American Brass Company Chemist uses Photo-Electric Colorimeter to analyze cooling water samples as a basis for tube alloy selection.

MEDIA BEING COOLED OR CONDENSED

It is not usually possible to change the corrosive properties of products being handled in the process industries. The venting of noncondensable gases, however, will markedly increase tube life. This is particularly true on the steam side of boiler feed-water heaters and other steam-heated equipment where accumulations of oxygen, carbon dioxide, and ammonia can cause rapid failure of condenser tubes.

TEMPERATURE

The corrosion rate of metals usually increases with increasing temperature. This is a problem particularly in refinery condensers where water velocities are often relatively low and the water temperature is relatively high. At low water velocities, the formation of gas bubbles on the water side of a tube can initiate pitting which may continue even after the bubble has disappeared. In such cases, a judicious increase in water velocity will insure longer tube life, provided the velocity is not increased to a point where impingement corrosion can occur.

Many believe that condenser tubes put in service in the winter when water is cool will last longer than those started in the summer. A more protective film of corrosion products forms on the tube wall in winter, probably because the water is freer of sulfides.

TECHNICAL HELP IN SELECTING TUBES

Your situation may require special consideration and analysis. We are always ready to help and advise in the selection of the right alloy to give best service. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8786

ANACONDA®

Tubes and Plates for Condensers and Heat Exchangers Made by The American Brass Company

PHYSICAL PROPERTIES OF ANACONDA CONDENSER TUBES*

ALLOY	Tensile Strength, psi	Yield Strength at .5% Elongation Under Load, psi	Elongation in 2", %	Rockwell Hardness, B Scale	Density, Lb. per Cu. In.	Thermal Conductivity, B.T.U./Sq. Ft./In./Hr./°F. at 68° F.	Average Coefficient of Linear Thermal Expansion per °F. (77-572 F.)
Arsenical Admiralty-439	52,000	22,000	60	6-45	0.308	768	.0000112
Ambralay-927	60,000	27,000	55	35-65	0.301	696	.0000108
Ambralay-901	60,000	30,000	60	30-60	0.295	552	.0000099
Cupro Nickel, 30%-702	55,000	22,000	50	30-60	0.323	204	.0000090
Cupro-Nickel, 10%-755							
Light Annealed	44,000	22,000	46	25	0.323	314	.0000093
Light Drawn	60,000	57,000	15	68			
Red Brass-24	42,000	15,000	50	0-30	0.316	1104	.0000104
Ambronze-421	46,000	20,000	55	0-30	0.316	830	.0000102
Phosphorized Arsenical Copper-108							
Light Drawn	40,000	35,000	20	20-50	0.323	1344	.0000098
Hard Drawn	54,000	50,000	8	50-70			
Phosphorized Copper-103							
Light Drawn	40,000	35,000	20	20-50	0.323	2364	.0000098
Hard Drawn	54,000	50,000	8	50-70			

*Note: The above values are approximate and should not be used for specification purposes. *Light annealed except as noted.*

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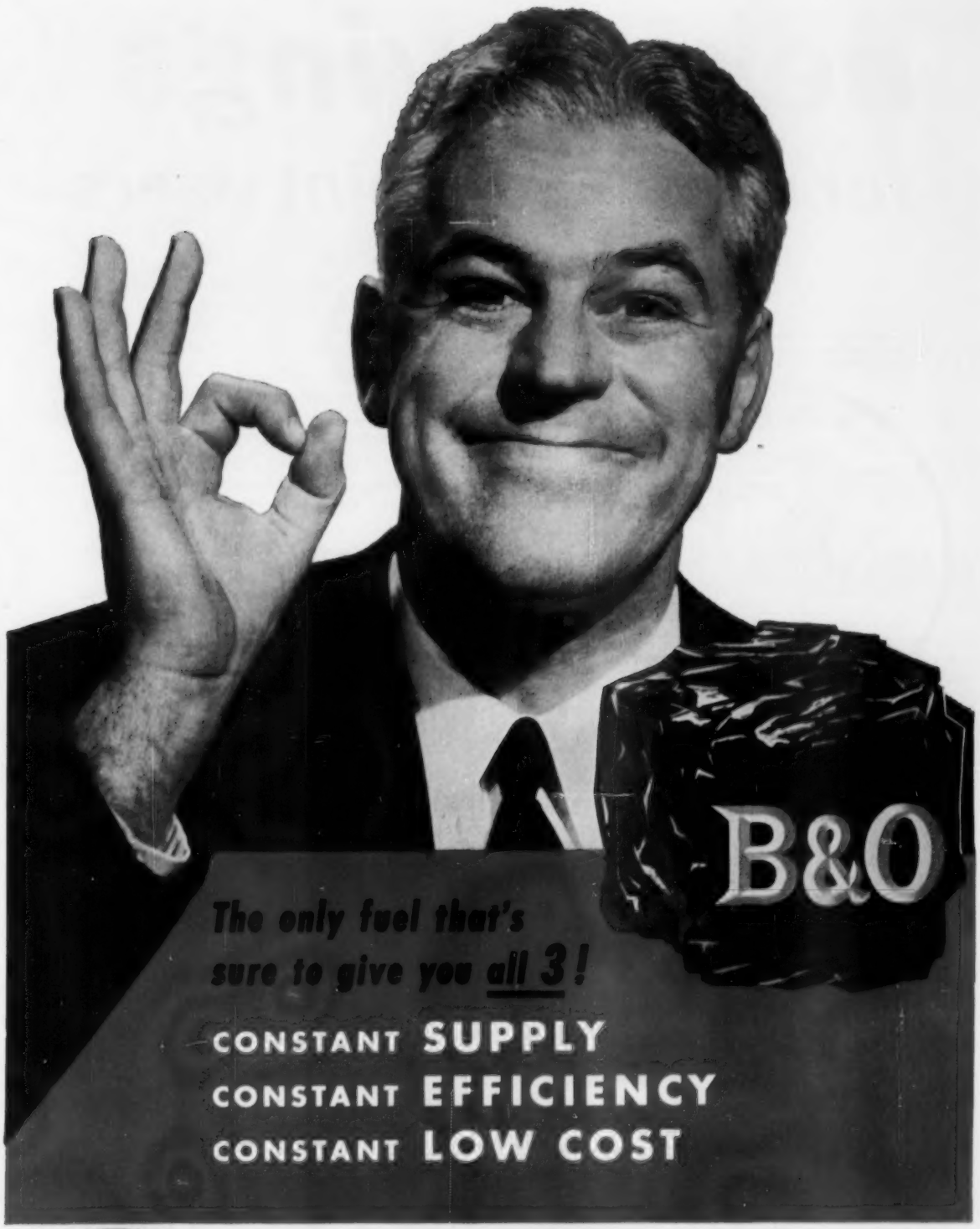

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Ask our Man! BALTIMORE & OHIO RAILROAD, BALTIMORE 1, MD. *Phone* LExington 9-0400

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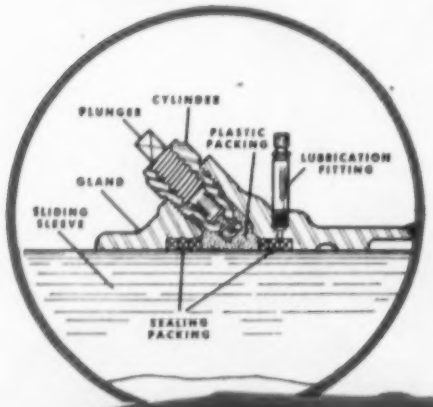
new savings
for expansion joint users

Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger.



The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

20" Yarway Type W Gun-Pakt Joint with base, single type, welding ends, 8 guns.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY GUN-PAKT

...a good way to specify expansion joints

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Fig. 1. **Before.** These stacks greeted the author. They spelled not only inefficiency, but poor public relations

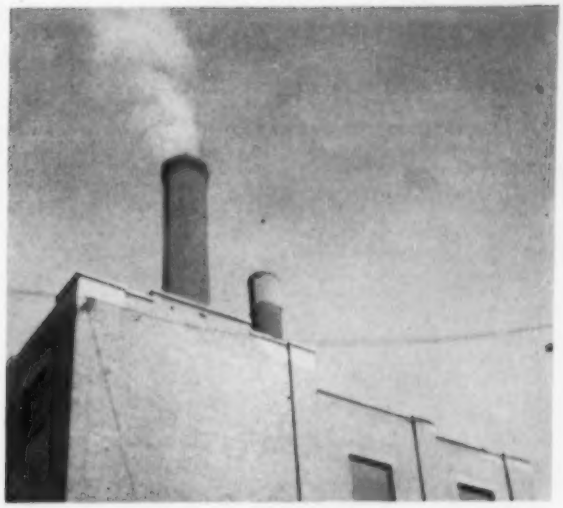


Fig. 2. **After.** With the steps described in this article completed, the sun began to shine, and the snow was white

Old Steam Plant — New Broom

By G. R. SETTERLUND

DID YOU EVER move into a new steam plant? . . . that is, new to you but actually very old, with four multi-retort stokers, modified beyond recognition, under boilers of 1916 vintage; three electric boilers of approximately 60,000-kw total capacity, two in dry storage, the third to be used only on advice when power is available; and three pulverized coal boilers, one 60,000 lb per hr, the other two 90,000, each. These present quite a picture the morning of the first day.

That picture becomes even dimmer at noon when you leave the plant with the stacks still belching black smoke. In the morning on the way in, the thought had flashed through your mind that the smoke was caused by coincidence. After lunch, the smoke still pours forth like something in Dante's Inferno, and you are brave enough to ask why.

"Oh, there's nothing wrong. The pulverizers do that all the time. They are over capacity." Curiosity leads you to the feedwater supply, and you hear that the boiler feed pumps slip at 175 F, with a positive suction head of 3 psig from an open hotwell. Maintenance is terrific. Close records are not available; but nearly every man in the plant has to come in Sundays to get ready for the next week. Perchance, at this stage, it would have been better to have stayed in the Air Force and played around with C.F. 100's.

But what a golden opportunity to try out your new wings as a chief! The plant had never, in past history, had an unscheduled outage that affected production, and, after the first impression, you realized that the staff were honest and willing, and that management would back you 100 per cent for results.

Here is the way the situation was handled with fair outcome. Others in similar situations may be able to pick out a few tips that could help them.

A meeting was held of all the shift foremen and operators who were available. It was pointed out that a complete change of operations was in the offing. Changes would be carried out or else! But a new superintendent could not do anything by himself and any suggestions would be most welcome. Since we were all going to live in this together, we would all work together. Any problems, complaints, requests for educational help, job instructions, etc, would be handled promptly, and chances for advancement in the future were assured.

During careful observation of the control panels, it was noted that the operators were continuously setting up bias on the selector valves or were taking control away from the automatic combustion control setup. Control air motors or jacks were all very sluggish or unresponding. Damper positions did not agree with external indications. The Instrument Section was called in to calibrate and check all instruments and controls. Dampers, control linkages, etc, were freed up and made ready for combustion tests. All control lines were cleaned, blown out and pressure tested.

Smoke conditions were even worse during soot-blowing operation and ash drawing. As a consequence, time was spent with the ash handlers, and it was noted that most of the clean-out doors in the ash pits were left open or partially open after cleaning. Soot blowers were operated on very high loads and perhaps at the same time as ash removal was being carried out. Even the clean-out door in the chimney was left open generally because it was used often.

These young ash handlers were ignorant of the correct ways of cleaning, so simple instructions were issued to the shift foremen, verbally and in writing, to rectify the situation through careful instruction and follow-up. There was doubt still as to whether or not pulverized coal units were over capacity, so conservative instructions for ash removal and soot blowing were issued, along these elementary but necessary lines:

1. Soot blowers were to be operated in proper sequence (direction of gas flow) for all boilers but never all three at the same time.

2. Loads would be lowered approximately 15,000 lb below what was considered peak load on each boiler before soot blowing and for ash removal.

3. Ash would not be removed when soot blowers were being used, to assure that ash handlers would not be burned.

4. Boiler masters would be set on hand or manual control to prevent load swings during ash removal.

5. Furnace draft controls would be held on manual with greater negative furnace draft to eliminate puffs in

the furnace and subsequent burning of ash handlers.

6. Total air flow would be adjusted as necessary when furnace doors were opened to maintain clean smoke-free conditions.

7. All clean-out doors and inspection doors would remain closed at all times unless in use.

8. All dust collectors would be cleaned twice every shift to be sure that they were not blocking or overloading (opportunity had not been available to inspect them as yet).

9. The clean-out door in the chimney was to be left closed at all times.

The sun started to shine — not continuously but quite often.

Steam flow meter data were checked against orifice data and original design data were checked against operating conditions — suspicions were verified.

Fig. 3. Cross-hatching on saddle extension of roller shows area milled off

Fig. 4. I.-d. fan and casing 10 months after relining. Check marks still show

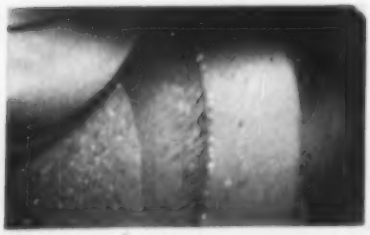


Fig. 5. Colmonoy-faced grinding ring reveals little wear after eight weeks

The boilers were not generating their rated capacities. Limiting factors appeared to be fans and pulverizers on the two 90,000-lb units.

Coal samples from the pulverizers indicated 90 to 95 per cent through 200 mesh. All classifier dampers were set to agree with external indications, and fineness was reduced to approximately 75 per cent through 200 mesh. This rather rough and hurried set of tests allowed ratings to be reached with ease but induced draft fans limited loads. Larger fans were installed, and an instrument engineer was called in for combustion tests, control calibration and paralleling. Smoke conditions were eliminated with loads 13 per cent over rating. Peaks of 110,000 lb can now be reached with only greying conditions. Panel operating instructions were issued. Close coöperation with the Instrument Section has resulted in controls remaining paralleled and giving excellent control.

Before the new fans were installed, the casings were relined with metal lath and refractory. The metal lath was tack-welded to the casing on approximately 4-in. centers, and the refractory was troweled on in two layers to a total thickness of about ½ in., the first coat just filling the lath, and being allowed to dry thoroughly before the second was applied.

Winter was setting in and it was brought to our attention that stokers would be necessary; how many with the increased production was still a matter of conjecture. Everything possible, at least, should be done to lessen the loads on the pulverizers. The feedwater pump "slip" story seemed rather vague so these pumps were opened and inspected, clearances checked, and general conditions noted. All were in order.

Feedwater temperature was raised in the hotwell by adding less cooling water resulting in temperatures rising to 195 F and make-up decreasing nearly 10 per cent. Rough calculations, based on average high loads, indicated that coal savings of $13,000 per year should result. It could not be determined that boiler capacity was increased likewise as close figures on coal consumption for each boiler was not possible due to common bunkers.

Two of the stoker-fired boilers in steady use had need of internal cleaning, but could not be taken out of service for this, so internal treatment was started. This was carried out carefully and with many qualms. A very dilute solution of internal treatment chemicals was started along with regular opening of intermittent blow-down valves. It was feared that any heavy scale would be loosened and would gather in headers, demanding a forced outage. Fortunately, each subsequent inspection of internals indicated a general clean-up was taking place and after about one month, standard feed dosages were admitted. After a full winter of operation under treatment, the boilers were virtually clean. A few handhole gaskets were changed after showing signs of leaking, however, and one of the blowdown valves had blocked slightly.

We began a study of our bowl-type pulverizers; three of the quartet were rejecting coal in excess. Rollers and grinding rings were on too-frequent order. Exhauster fans were wearing out after handling 4000 to 5000 tons of coal. A 10 per cent overrating was being carried at all times so extra maintenance was expected. Memory indicated, however, that not even this high maintenance was in excess of that on previous lower loads.

Spring tensions were increased from ¾ in. to 1 in., and clearances between rollers and grinding rings were increased from 3/16 in. to ⅜ in., with instructions not to set up clearances until they reached ½-in. In an attempt to keep roller faces parallel to the grinding ring face, it was found that a limit was reached and much metal remained on the ring. All saddle extensions were removed, and 1 in. was milled from the convex edge nearest the pulverizer body. Now paralleling could be carried out until the rings actually wore through to the bowl. Rollers are actually wearing down more evenly, but have not been in service long enough since the modification to predict their life. Lock nuts holding the rollers to the journals will be counter-sunk this summer to eliminate nut wear. Small classifier adjustments maintain fineness within limits.

Heavy loads were blamed for excessive rejects, but oddly enough one pulverizer seemed to handle high loads with no problem. Careful examination revealed nothing different in it than the others. The extreme right-hand pulverizer was the worst culprit, with decreasing severity toward the extreme left-hand unit.

Perhaps you have run into a kind of superstition that all right-hand auxiliaries give more trouble than left-hand ones? In this case, however, it was determined that the extreme right-hand pulverizer was definitely getting coarser coal, and theoretically more stones, rocks and foreign material than the others. The method of charging the bunkers was varied in order to achieve uniformity, and slight improvement was noted, but the difficulty was not eliminated.

As you know, there is a ring extension angle fastened to the top of the grinding ring, forming a restriction through which the mill air must pass on the way through. It was decided to weld a 1-in. extension to this ring and thereby decrease the clearance slightly, increase the velocity through this area, and thus keep the coal in the bowl, allowing the true rejects to fall out. This was carried out and the excessive reject problem has ended. The deflector plates in the mill are being retained now because they were cut virtually in the right place to make room for the extended

extension ring. It saves grinding them.

Re-blading exhauster fans with various abrasion-resistant plates can be interesting — some are economical, others not. We have gained much needed knowledge, however. At first we simply used different types of metals; then we started facing blades by welding alternately with different rods to get a fair picture, Colmonoy, Stellite, Tube Borium, etc. Warping prevented the blades from being faced while installed on the spiders. Jigs were made up to weld before riveting to the spiders. That problem solved, we were able to get about 20,000 tons through these treated exhausters.

We hoped then to re-touch the blades. But the spiders now showed signs of wear, so we hardfaced the worn parts. Operations were progressing smoothly when after six weeks of operation with a touched-up spider, what happened? One exhauster fan through the casing. Our boldness had not paid off. Internal stress with subsequent cracking had developed within the spider. A pattern is being made now to cast a heavier webbed spider which should outlast the blades. How far will this go? We hope for 30,000 tons.

Stelliting the scraping edges of the reject scrapers more than doubles their life. We had a test set cast from chrome-nickel-cast alloy that was put into service, but results are not yet known.

Accurate but simple records are being kept of all changes, life duration, etc, of parts replaced in order to predict future needs and honestly assess their values.

Life is never dull in a steam plant nor is it dull or non-rewarding on the street outside the plant. Christmas week was wonderful and as I went for the mail on a cheery afternoon, a stranger stopped and remarked that it was "the first white Christmas in years — how did you do it?" After some pondering the light dawned. The sun was shining and the snow was white, with no dirty black carbon to soil children's snow-suits. Clothes could now be dried out of doors. "It's not my fault," I proudly grinned. "A chief cannot do anything by himself. Thank the boys for their coöperation — the firemen and the helpers, the ashmen and their foremen. They are the people who do the work and live in Our Town."

WOULD YOU LIKE TEAR SHEETS?

Readers wanting tear sheets of any article appearing in the issue for their personal file may obtain them by indicating the item desired on one of the post cards appearing in this issue—Editors.

How To Protect Your Structures With Dynamometers

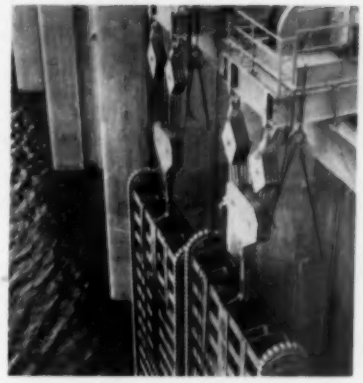


Fig. 1. Dynamometers (arrows) protect gate structure at big Chief Joseph Dam

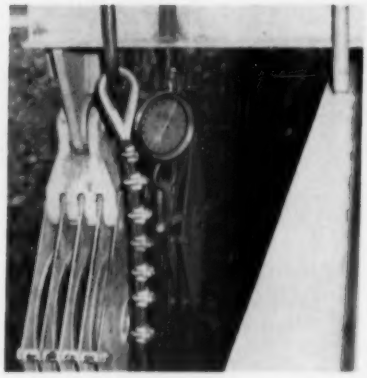


Fig. 2. Dial indicates when hoist load is nearing 100-ton predetermined limit

UNIQUE application of dynamometers in the prevention of overloads on the hoisting equipment for the sluiceway gates at this dam illustrates effectively a method of protecting equipment and structures under circumstances frequently arising in operation, maintenance and construction. In these views the hoist riggings have 16 parts of line, and the dynamometers are installed at the becket ends so that loads reaching the instruments are within their 20,000-lb capacity. The danger-point dial reading has been precalculated at 11,250 lb, which corresponds to a total load on the hoist of 100 tons, beyond which a beam failure might occur, with the loss of hoist, trolley beam and gate — a catastrophe of immense proportions.

In addition to such permanent installations where the total load can surpass the point of safety unless checked during operation, there are many occasions when existing structural members may be subjected to unknown loads, as in lifting items of undetermined weight, attempting to free frozen parts, or winching. These members should be examined, and their maximum loading calculated, using an appropriate factor of safety. Then use a dynamometer as illustrated to prevent a disaster which might prove not only costly but embarrassing.

For more information, write the Editor, POWER ENGINEERING, 308 E James St, Barrington, Ill., or jot down Dynamometers on return post card in this issue.

Norton Increases Steam Capacity by 75%

INSTALLATION of steam generating equipment that will increase by 75 per cent the capacity of its main power plant will be the final project of Norton Co's present expansion program. Over a million dollars will be spent on the boiler, power house addition and new coal handling equipment.

Contract for the boiler has been awarded to Riley Stoker Corp of Worcester, Mass. It will be designed to generate 150,000 lb of steam per hour at 700 psi at 750 F.

To serve the new boiler, considerable accessory equipment will be installed. A new wing will be added to the power house, a second 200-ft high stack will be built and major changes will be made in the coal storage and handling facilities.

The boiler is designed to burn pulverized coal, oil, or gas through the same burners so changeovers from one type of fuel to another could be made with no interruption of service.

The new boiler is necessary to provide additional steam for process operations and heating in the winter. Power generation is of secondary consideration. More efficient operation of the plant should result when the new boiler becomes the primary steam generator, with the present boilers being added to the line to handle heavy demand.

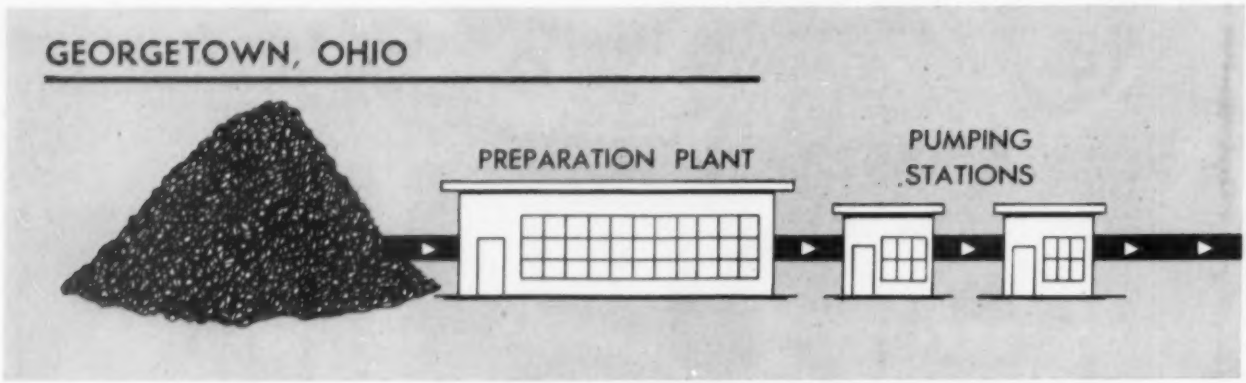


Fig. 1. Mountain of coal outside the preparation plant in Georgetown; more grinding, plus water, will make slurry

Fig. 2. Settling tanks at preparation plant at Georgetown, near Cadiz, Ohio, help get coal ready for 108-mile trip

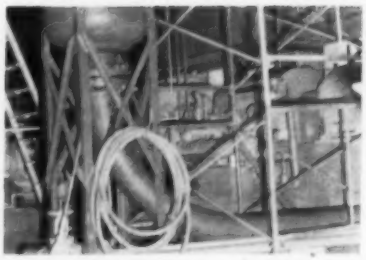


Fig. 3. Start of the coal pipeline is shown in this photo of No. 1 pumping station; pipe at bottom is first link

Coal Flows to Eastlake Power Plant In Trial of New Pipeline

FIRST SHIPMENT of coal moved to the Eastlake (Ohio) generating plant of The Cleveland Electric Illuminating Co recently after being pumped through the world's longest coal pipeline.

Pipeline engineers said the coal was a test shipment.

Operation of the pipeline is on a trial basis. Initial tests had been run for a portion of the pipeline as engineers made inspections. Latest test run was the first time coal had moved through the entire pipeline. Earlier operational problems, which had been anticipated, have been overcome.

Finely ground and mixed with water to form a slurry, the coal was started on its way from a mine at Georgetown, near Cadiz, Ohio, for the 108-mile trip to Eastlake.

Operating 24 hours a day, the coal pipeline is designed to carry 1,300,000 tons of coal a year to keep four turbine generators operating in the company's Lake County plant. The plant is on the shore of Lake Erie, about 22 miles east of Cleveland.

Three pumping stations hurry the slurry along the route. Calculated time for the slurry to move from Georgetown to Eastlake is about 35 hours (4 mph).

Pipeline, pumping stations, preparation plant, and drying plant were constructed at a cost of $12,500,000 by Pittsburgh Consolidation Coal Co, the owner. This is the first coal pipeline in the world longer than 10 miles.

Starting point of the pipeline is at the mine's preparation plant. The coal, mined by giant power shovels, is crushed and mixed with clear pond water for the trip north.

Pipeline was laid in four months by the Williams Brother Co of Tulsa, Oklahoma, one of the largest pipeline firms in the world. Laying as much as two-and-a-half miles of ten-and-a-half-inch pipe a day, workmen buried the pipe to a depth of at least four feet to avoid freezing conditions.*

Furnaces at Eastlake consume 1,600,000 tons of coal a year. Illuminating Co engineers estimate that the pipeline will supply 80 per cent of the plant's annual fuel needs, which represents about 50 per cent of the fuel requirements for the Company's entire system. The rest of the coal needed at Eastlake will be shipped in the conventional manner.

The company has a 15-year agreement with Pittsburgh Consolidation for the supply of coal via the pipeline. In addition, at the end of that period the company will have acquired ownership of the drying plant under a purchase-rental plan.

Ohio's coal supply is expected to be good for many years to come. Thus, at the rate Illuminating Co plants consume coal, the pipeline will mean important cost reductions in freight charges, even if the rates of the future went no higher than they are today.

*See: Coal Pipeline Nears Completion, POWER ENGINEERING, October 1956 issue.

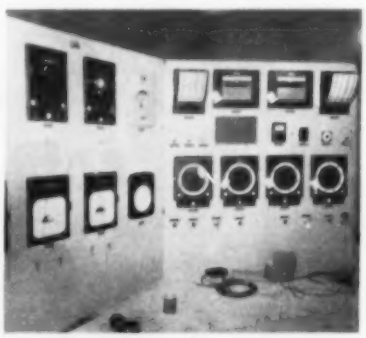


Fig. 7. Control room in drying plant at Eastlake. There is leased telephone line to Georgetown preparation plant

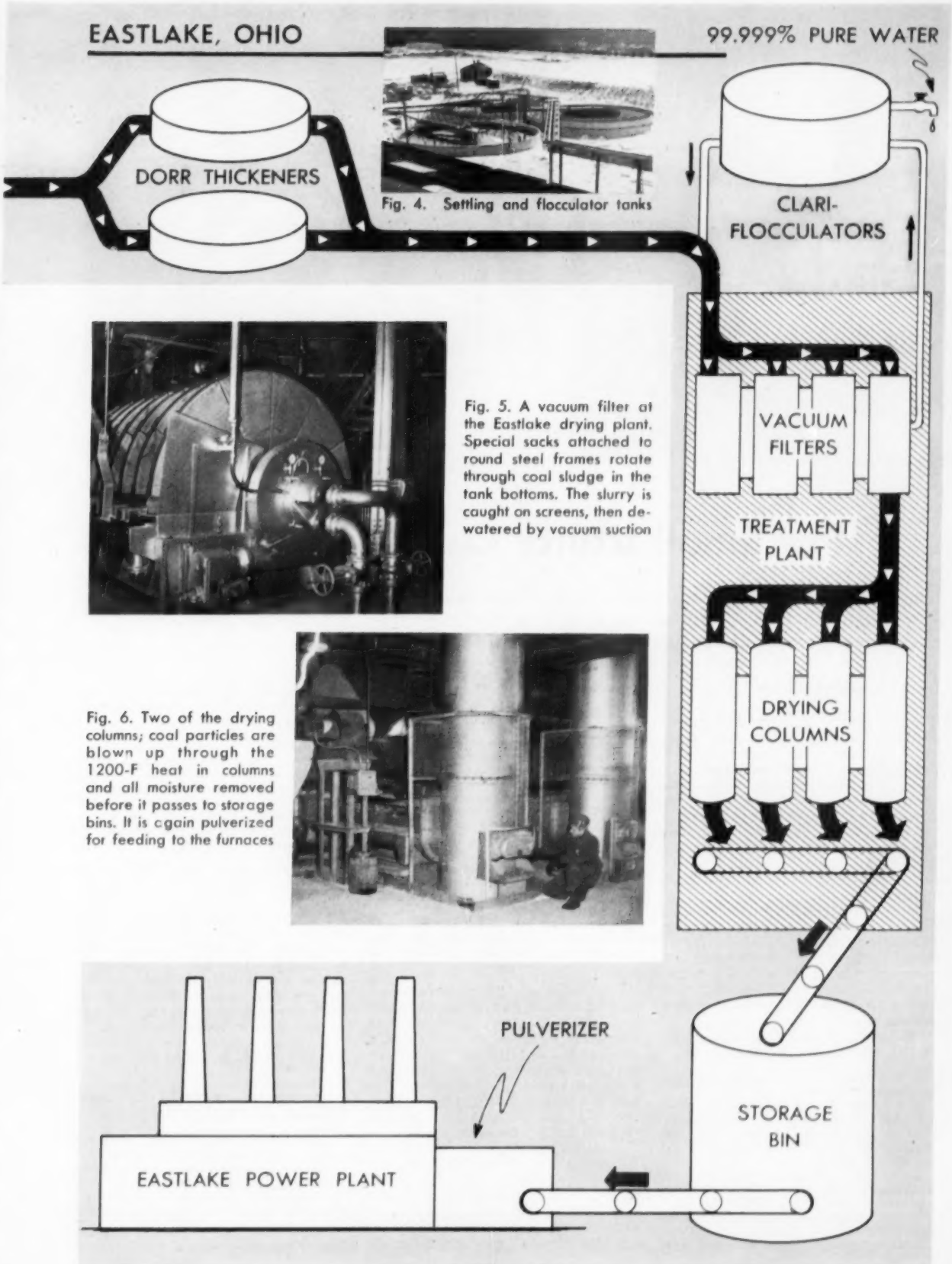


Fig. 4. Settling and flocculator tanks

Fig. 5. A vacuum filter at the Eastlake drying plant. Special sacks attached to round steel frames rotate through coal sludge in the tank bottoms. The slurry is caught on screens, then dewatered by vacuum suction

Fig. 6. Two of the drying columns; coal particles are blown up through the 1200-F heat in columns and all moisture removed before it passes to storage bins. It is again pulverized for feeding to the furnaces

Fig. 1. Diesel was in place on foundation before building was up

Fig. 2. Woodstock (Ill.) municipal power plant (left) shows how sound engineering and good management help utility serve community

How Small Utility Cured Growing Pains

Five-and-a-half years ago this small municipal utility was faced with a growing load, insufficient capacity, and low plant efficiency. Here's how good management practice made plant pay off

By S. L. GUNDERSON *

IN JANUARY 1952, the Woodstock Power & Light Plant was at a very low ebb both physically and financially, and employee wage rates were considerably below scale in the area.

Figure 4 indicates that net income for the period 1948 to 1952 was hovering at a low point; furthermore, out of the amount shown, $66,000 was transferred to the general fund of the City, leaving very little for capital improvements and expansion. In fact, in 1950 the earnings were not adequate to make the regular transfer of funds to the City. Much more could be related about problems encountered, but the foregoing will suffice to show that we faced a very serious situation.

Following is an outline of what we did to rehabilitate the plant:

1. Took immediate action to improve physical condition of equipment.
2. Eliminated losses to atmosphere and sewer, and made other improvements in the heat balance.
3. Selected the most economical coal that met our specifications by competitive bids on a Btu-per unit-cost basis.
4. Checked all instruments and meters and established accurate data and records on plant operation.
5. Brought equipment up to the highest practical operating efficiency.
6. Improved design and corrected many operating problems in boilers and turbine generators.
7. Rebuilt coal and ash handling equipment, including two concrete silos.
8. Improved lubrication procedures.
9. Trained operators and built up a maintenance force.
10. Practically all maintenance done by our own force instead of calling in outside help at high daily rates.
11. Outside firm called in to make a wage study, determine rates for the various types of work, and establish job classifications and specifications, including all conditions of employment. (This applied to all City employees.)
12. Improved physical condition of the entire plant, including buildings.
13. Established daily control of water conditions pertaining to boilers, boiler make-up and circulating water. Boiler make-up reduced from 10 per cent to 1 per cent.

In the spring of 1955 we were confronted with a request for an additional 2800 kw within six months as a result of an anticipated increase in production capacity by our largest industrial customer, who at that time had a peak demand of 3400 kw. This increase consisted principally of synchronous motors, two 800 hp and two 400 hp, for d-c generation.

Our plant in 1955 consisted of the following: One boiler and turbine generator of 7500-kw capacity at 400 psi, 750 F TT, three standby boilers, two standby turbine generators of 6500-kw capacity at 200 psi, 540 F, and one 300-kw diesel unit for emergency station power. Basically, our firm capacity was 6500 kw, and the generator load was 7000 kw (See Fig. 4). Capacity of the cooling tower was limited in warm humid weather to our firm capacity or 7500 kw at the higher initial steam conditions.

The problem finally resolved itself into two possible solutions:

1. Installation of a new boiler and turbine generator of 7500-kw capacity plus a cooling tower addition, and replacement of our old switchgear at an estimated cost of $1,732,000.
2. Installation of a dual-fuel diesel generator of approximately 2500-kw capacity, plus a cooling tower addition and new switchgear at an estimated cost of $550,000.

It was decided to go ahead with the latter proposition, and in March 1955, a dual-fuel 16-cylinder V-type supercharged diesel engine generator of a rated capacity of 2610 kw was purchased. The engine was delivered and placed on the foundation as soon as the foundation was ready, before the building was erected. Erection work was completed and engine ready to run on oil in November, 1955.

A diesel engine generator was selected for the following reasons:

1. Lower investment.
2. Uncertainties of the future of our industrial load—approximately 65 per cent of the total load.
3. We have no tie-in with other utilities, and the diesel would give us a source of power which would carry the domestic load in case of a failure of the steam equipment.
4. Diesel generator to serve as a peaking unit when the electrical load exceeded the capacity

* Superintendent, Woodstock Power & Light Plant.

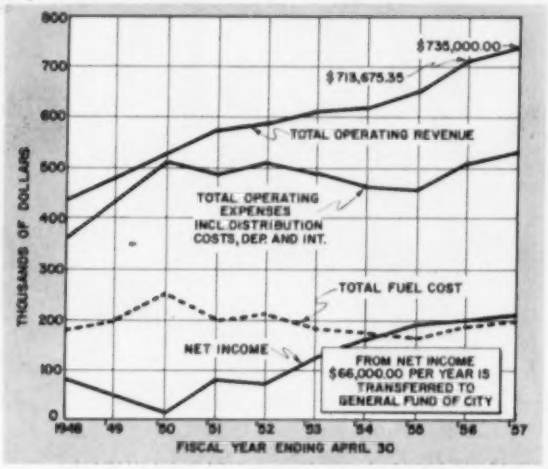

$735,000.00
$713,675.35
TOTAL OPERATING REVENUE
TOTAL OPERATING EXPENSES INCL. DISTRIBUTION COSTS, DEP. AND INT.
TOTAL FUEL COST
NET INCOME
FROM NET INCOME $66,000.00 PER YEAR IS TRANSFERRED TO GENERAL FUND OF CITY
THOUSANDS OF DOLLARS
FISCAL YEAR ENDING APRIL 30

Fig. 3. The financial story of Woodstock Power & Light Plant

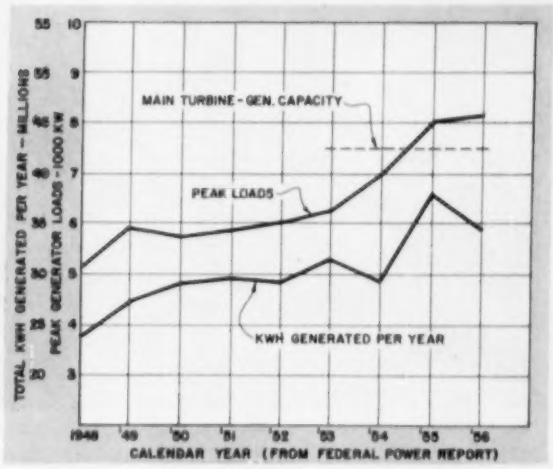

MAIN TURBINE - GEN. CAPACITY
PEAK LOADS
KWH GENERATED PER YEAR
TOTAL KWH GENERATED PER YEAR — MILLIONS
PEAK GENERATOR LOADS - 1000 KW
CALENDAR YEAR (FROM FEDERAL POWER REPORT)

Fig. 4. Record of Woodstock's power generation, 1948–1956

of our 7500-kw unit, instead of placing a 200-psi boiler and turbine on the line to take care of peaks of two or three hour duration, thereby improving the load factor of the main boiler and turbine unit.

5. Diesel generator to increase our firm capacity from 6500 kw to 9000 kw, deferring the installation of a new boiler and turbine for several years.

The cost of the diesel unit installed complete, including building, gas meter house, part of cooling tower addition and engineering was $393,000 or $150 per kw.

Gas is not available during the winter months when we have our heavier load. Hence, peaking with the diesel during the winter is accomplished on No. 2 fuel oil, 137,000 Btu per gal, at 13.131 cents per gal (during the past winter), or a fuel cost of 98 mills per kwh with an average heat rate per kwh of 10,230 Btu at one-half to three-quarters load. Gas is available at the low rate from April 15 to November 1.

Thus far we have not needed the diesel unit for peaking during the summer; however, during the summer of 1956, we operated the unit as a dual-fuel engine about 7 hr per day and 5 days per week at three-quarters load. Fuel and lube oil cost ran approximately 52 mills per kwh — practically identical with our coal cost at 30 cents per million Btu in 1956.

The diesel unit has proved to be a quick source of power that can be put on the line in about five minutes or less. It has pulled us through several times and prevented dumping load when there was some minor mechanical trouble with the stoker. On Sunday, May 26, 1957, the diesel unit carried the entire City load from 1:00 A.M. to 5:00 P.M., when it was necessary to shut down our cooling tower to clean a condenser because a 24-in. butterfly valve would not close tightly enough to permit draining the condenser. During this time, the load varied from 1100 to 2200 kw. We have a raw water connection for engine cooling water in emergencies.

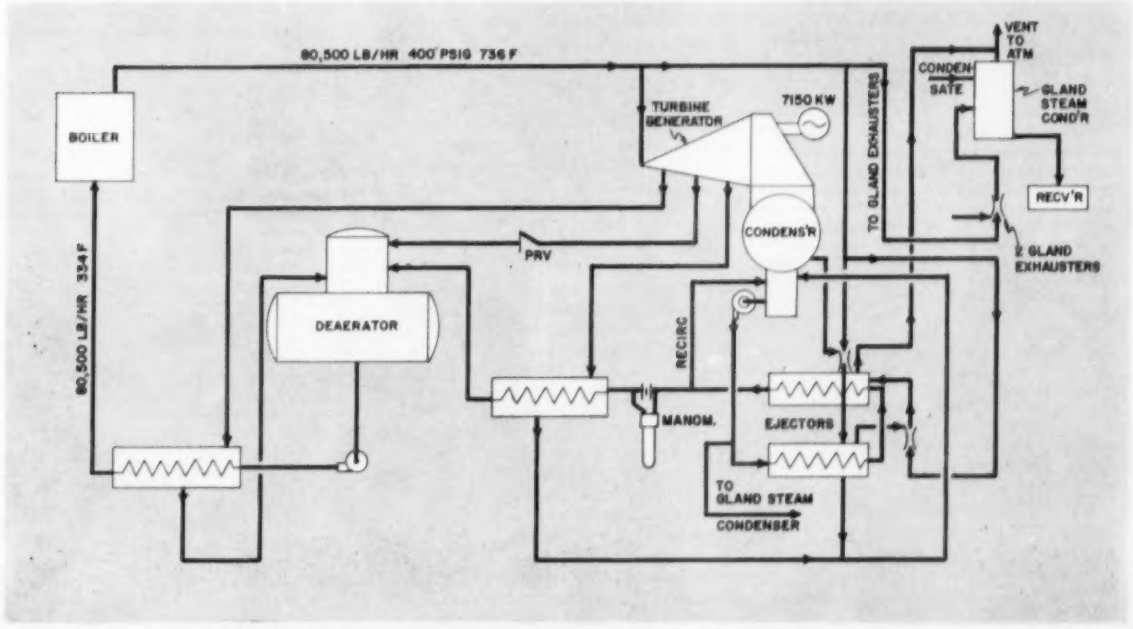


Fig. 5. Diagram of 7500-kw turbine generator, the primary load-carrying unit; overall thermal efficiency 23.0%

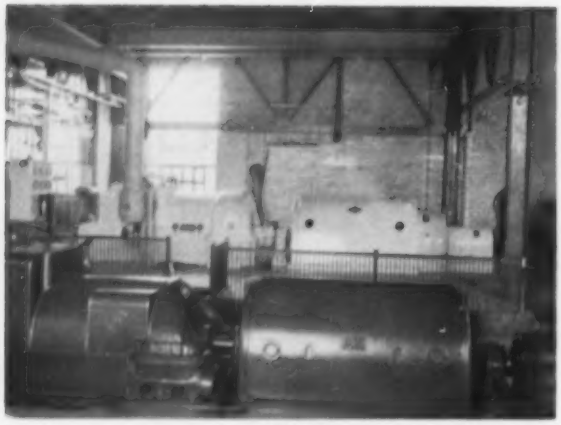


Fig. 6. Generating room at Woodstock; DeLaval unit is in background, 4000-kw Westinghouse unit shows in foreground

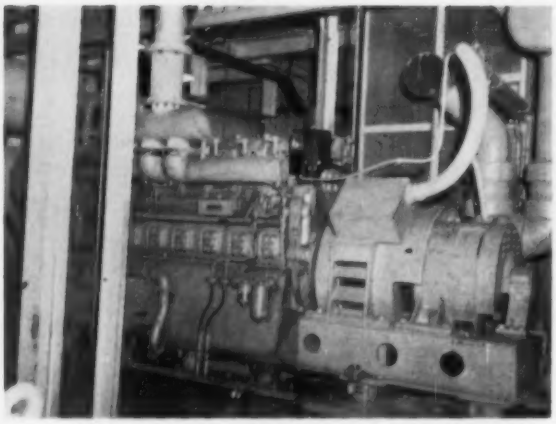


Fig. 7. Abbreviated view of 300-kw General Motors diesel used for standby and emergency service at Woodstock plant

Up to the present time, the diesel has not improved the over-all economy of the plant because the interest and depreciation charges have been far greater than the savings effected during the winters of 1956 and 1957 when it served as a peaking unit with oil as fuel. However, it has provided the standby capacity necessary to maintain 100 per cent firm power.

If gas were available twelve months of the year at the present summer rates, dual-fuel diesel operation would place this unit on a fairly even keel with the coal-fired steam plant. However, we are well satisfied with steam operation. Our main boiler regularly stays on the line for three to six months at a time, and the turbine from two to three months.

The question of what size of engine generator to buy was one of the problems on which there was varying opinions. The author has always been of the opinion that two 1250-kw units instead of one 2500-kw unit would be more practical for several reasons:

1. It is not practical to run a diesel engine generator at less than half load, and when the engine is used as a peaking unit, the excess load beyond the capacity of the turbine generator will vary from zero upward. During the past two years our load during the winter has exceeded the rated capacity of the 7500-kw unit by a maximum of 1000 kw, but in order to obtain good performance of the engine we have operated the engine at 1300 to 1500 kw, which affects economy adversely when fuel oil is 13 cents per gal.

2. Engine efficiency with two smaller units would be better because the engines would operate on the average at a higher percentage of rated capacity.

3. Having two 1250-kw units would offer more security and would not cripple the entire diesel plant when outage is necessary for maintenance. In other words, we wouldn't have "all our eggs in one basket."

The cost of two 1250-kw units installed may be slightly higher, but this depends on whether or not package units are suitable, depending on the type of service and size required. It may be difficult to justify the additional cost of the dual-fuel features for standby and peaking service only.

Our coal is purchased on a highly competitive basis; we receive twenty of more bids, usually. Heat-dried coal is bought in the winter which unloads freely with the use of a vibrator. One man takes care of coal unloading and ash handling plus several other duties, whereas it used to take several men to unload frozen coal.

As to lubrication, a survey was made by our main supplier of lubricants to determine our requirements. As a result the number of types of grease and oil were reduced to a minimum. The lubricants are all kept in a clean room designated for this purpose only. Grease guns are filled by pressure pump, eliminating the open handling of grease. A card system has been set up for each piece of equipment designating the lubricant and frequency of application. Cards are located near each piece of equipment. Regular manila file folders are used and tacked to a board on the wall, one half of the folder serving as a hinged cover to keep the record clean. In some cases mimeographed forms are made and tacked inside the folder. We feel that improvement in lubrication has reduced equipment outage and maintenance expense to a great extent.

Regular megger readings of electric equipment have also paid off in reduced breakdowns and expense. All motors are checked with a megger at least once per year and readings plotted on a card for each piece of equipment. Exciters and the main field rotors are checked more often. Recently we found the main field rotor of one of our generators had a low reading of 25,000 ohms whereas it normally was four to six megohms. It was necessary to pull the rotor and remove the end bells and give it a thorough cleaning to restore the insulation reading to 4 megohms. A possible burned-out generator and extended outage was averted, although this job required two weeks and a total expense of approximately $5000. Apparently the trouble was due to carbon and copper dust from the exciter. The air cooling system of the exciter has now been segregated from the main generator system.

Our boiler make-up water system — consisting of resin bed, cation and anion units — are now producing good quality water as a result of correcting some difficulties in the equipment, and more important, because of good performance on the part of the men who operate this equipment. The cation unit is regenerated about every five days and the anion unit about every 10 days, which is a greatly reduced schedule compared with the days of 10 per cent make-up.

We have had no serious power failure since 1953, except for about a

Table I. Summary of data from annual reports of the Woodstock power plant

Coal used, tons	24,997
Cost of coal	$191,170.98
Diesel oil used, gal.	47,602
Cost of diesel oil	$6046.97
Gas used, therms	142,483
Cost of gas	$5441.44
Total cost of fuel	$202,659.39
Kwhr generated by steam	33,663,000
Kwhr generated by diesel	2,026,400
Total kwhr generated	35,689,400
Total steam generated, lb	437,094,196
Total steam to turbines, lb	410,622,165
Steam generated per lb of coal	8.75
Net steam per kwhr generated, lb	12.20
Total coal per kwhr generated, lb	1.484
Plant heat rate, btu	18,059
Heat rate per kwhr generated, diesel	10,230
Average fuel cost/kwhr, steam, cents	0.567
Average fuel & lube oil cost/kwhr, diesel, cents	0.628
Combined average cost/kwhr, generated, cents	0.571
Station power used, kwhr	2,581,501
Total kwhr sold	31,720,184
Total operating revenue	$738,828.01
Total operating expenses, including distribution, office, administrative and depreciation	$533,560.58
Net income	$205,267.43

twenty-minute period this year between 4:00 and 5:00 A.M., on a Monday morning.

As shown by Fig. 4, the fiscal years ending April 30, 1949 and 1950 were lean years for this plant. In 1950, a new 7500-kw turbine generator was placed in operation with steam conditions stepped up from 215 psi, 500 F TT to 415 psi, 750 F. Figure 4 shows that there was a slight improvement in economy for years 1951 and 1952 with a net income of approximately $80,000 as a result of the new generator operating at higher initial steam conditions. Figure 4 also shows the downward trend in fuel costs and operating expenses while total sales or operating revenue constantly increased. The "Net Income" curve has flattened out since 1955 which is due principally to the increase in interest and depreciation charges on the 1955 job and higher costs in general. However, the higher fuel cost (80 cents per ton) is fairly well offset by a coal clause in the industrial rate. During the past five years we have made capital improvements of approximately $828,000, and we have enough resources on hand as of April 30, 1957 to equal all our indebtedness, except approximately $65,000. During this time we have built up from an operating deficit into a substantial annual surplus during a period when maintenance work was extensive, supplies and parts were constantly advancing in price and labor costs were increasing 35 to 40 per cent.

Much of our success can be attributed to the good work and cooperation of the operators and maintenance men, as well as to an efficiently-operated distribution department. A good percentage of our men are taking correspondence courses, the City paying 60 per cent of the cost. The employees are encouraged to study and improve themselves, and good books and magazines are available to them at all times.

One of the most pressing problems of a utility today is the high cost of expansion to meet rapidly growing electrical loads. In order for a small municipal plant to stay in business in competition with large, well-managed private utilities, good management is imperative — and this includes good engineering design, selection of the proper equipment, efficient operation.

After five and one-half years of work on this job the author feels that the plant is in good physical condition and operating very close to design efficiency.

Table II. List of equipment at Woodstock Power & Light plant; note diversity

7500-kw generator—4160/2400 v	Electric Machinery Co
Steam turbine, 400 psi, 750 F.	DeLaval Steam Turbine Co
4000-kw generator—4160/2400 v	Westinghouse Electric Co
Steam turbine, 200 psi, 538 F.	" " "
2500-kw generator—4160/2400 v	General Electric Co
Steam turbine, 200 psi, 538 F.	" " "
2610-kw generator—4160/2400 v	Elliott Co
Diesel engine, dual-fuel	Nordberg Manufacturing Co
300-kw generator—440/220 v	Westinghouse Electric Co
Diesel engine	General Motors Corp
#1 Boiler—422 hp, 215 psi, 500 F.	Babcock & Wilcox Co
#2 Boiler—550 hp, 215 psi, 500 F.	" " " "
#3 Boiler—615 hp, 215 psi, 500 F.	" " " "
#4 Boiler—90,000 lb/hr., 415 psi, 750 F.	Wickes Boiler Co
Firing equipment—chain grate	LaClede Stoker Co
Controls and Instruments	Bailey Meter Co

Coal Crusher Mounting Solves Vibration Problem

ONE OF THE toughest vibration problems in a power plant has been solved economically with neoprene mounting pads at the Long Island Lighting Company's new 180,000-kw E. F. Barrett Power Station at Island Park N. Y.

Fourteen small stacks of cross-ribbed Isomode pads costing less than $200 completely absorb the severe vibrations of the station's 17-ton coal crusher and drive motor (Fig. 1). The major vibration is caused by the rotation of the crusher's 8600-lb rotor and occurs at a harmonic of the motor speed of 326 rpm.

The cross-ribbed vibration-isolating pads are made by MB Manufacturing Co of New Haven, Conn., and are located in stacks of five layers each at 14 positions between the bed plate and anchor frame so that the entire structure floats on neoprene with no bolts or other attachment.

The plan view of the bed plate (about 13 ft long and 8½ ft wide) in Fig. 2 shows the three pad sizes spotted to provide uniform load distribution. Eight stacks of the largest size are located along the sides of the crusher, while fewer of the smaller size are placed under the lighter 250-hp crusher motor and coupling housing to give a loading factor of 50 psi.

As shown on either side of the four outer corners of the bed plate in Fig. 2, additional stacks of three layers of mounting pads have been placed between pairs of vertical welded steel plates on the bed plate and anchor frame in the event that horizontal vibration forces develop.

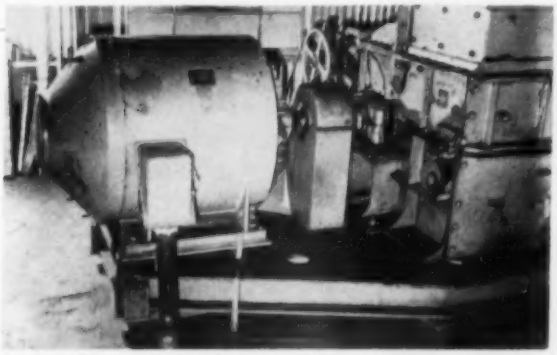


Fig. 1. 17-ton coal crusher and drive motor at Long Island Lighting Co's new 180,000-kw E. F. Barrett Power Station

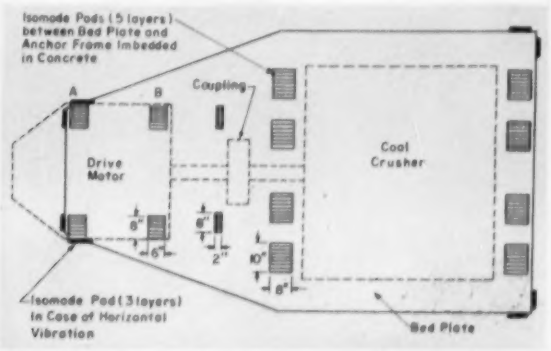
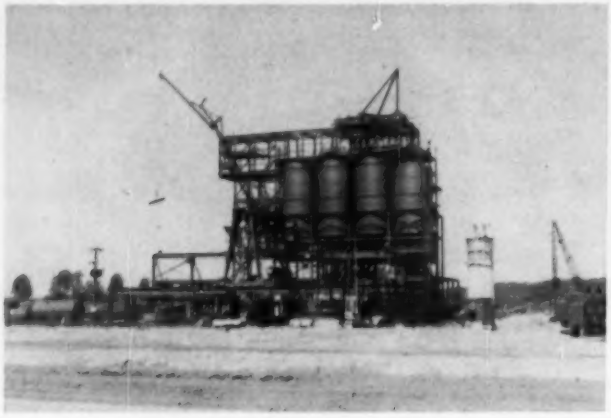


Fig. 2. Vibration problem of the assembly has been inexpensively solved by mounting on cross-ribbed neoprene pads

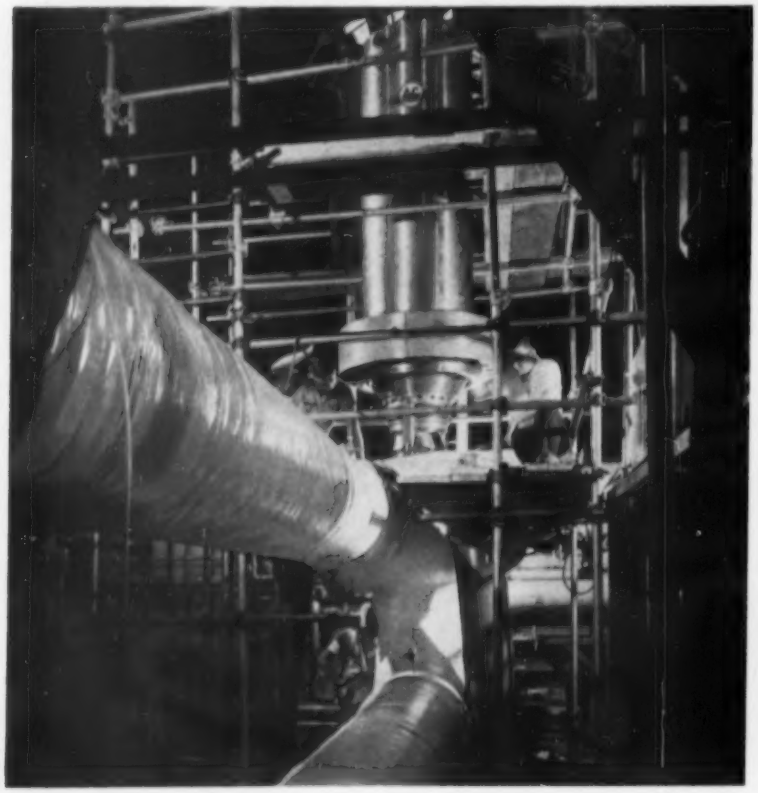
Bees Believe in Electrical Living: Swarm led by queen bee started housekeeping in GE motor awaiting shipment; apiarist-employee took motor apart, removed queen safely after 3-hr hunt—P.S. Nobody was stung

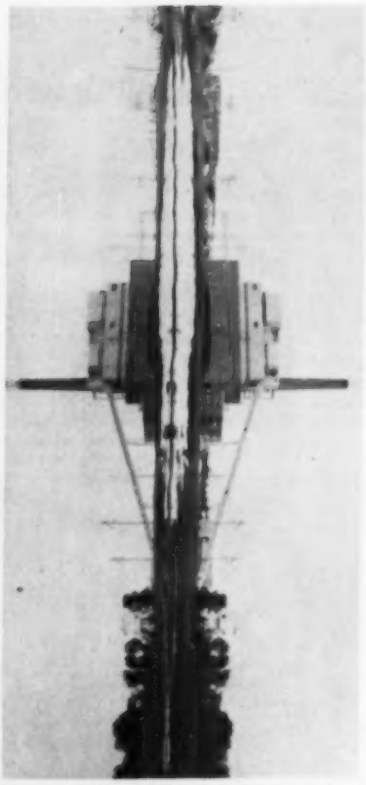
Outdoor Power Plant in Minnesota is being built by the Minnesota Power & Light Co about 90 mi northwest of Duluth. Another Ebasco-designed outdoor plant is about as far north, in Billings, Montana. Large cylinders are the coal storage bunkers



POWER ENGINEERING'S

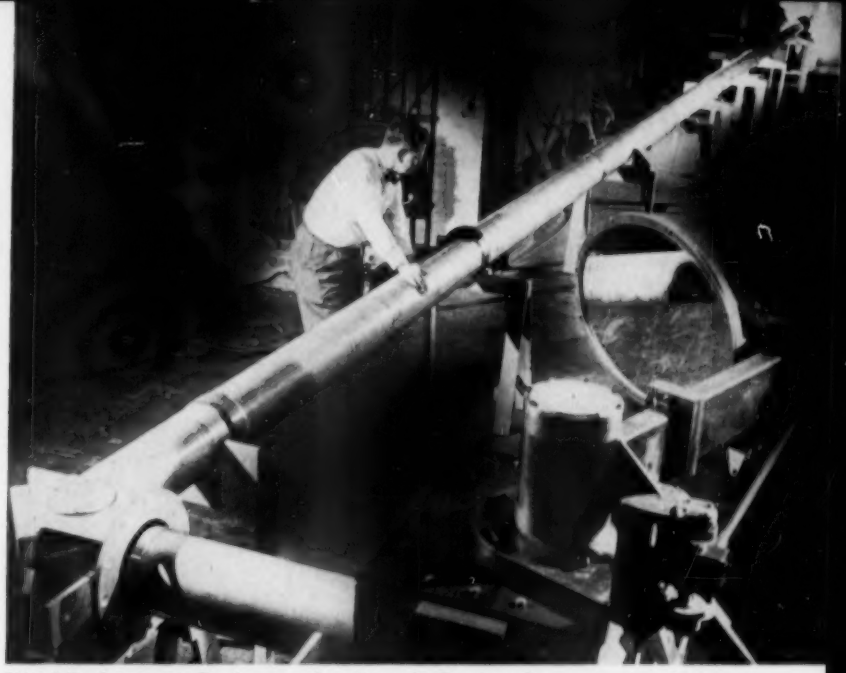
Radioactive Water Will Be Pumped through reactor and heat exchanger at Shippingport plant of Duquesne Light Co by this canned-motor pump. Built by Allis-Chalmers to handle 18,300 gpm at 111 psi, it is tested at 2000 psi, 500 F. Two of these units are main coolant pumps. Motors are 2300-v, two-speed design





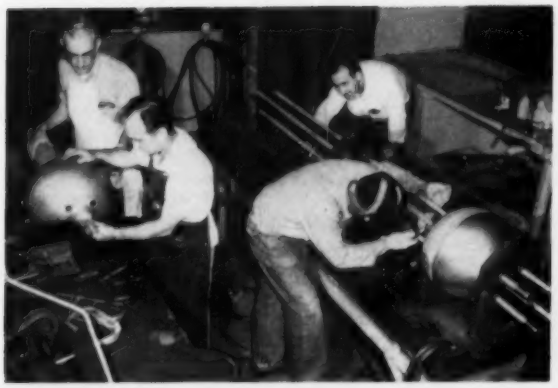
Know What This Is? Snapped by our Associate Editor Bob McCaw on recent field trip, this picture had most of us fooled a while. (Turn page sidewise)

Little Man, Big Job: Gene David, 40-in.-tall welder, was only man able to repair weld inside 18-in. stainless steel pipe at Shippingport atomic plant



World's Longest Periscope for Atomic Researchers permits observers to sit safely behind heavy shielding while they watch performance of nuclear reactor being tested at National Reactor Testing Station near Idaho Falls. Developed by GE, 90-ft unit with 60-ft partner shows both sides of hot reactor

NEWS REEL



U. S. Reactors for Europe are being built here by several companies. Top, cores for West German research are made by Atomics International; Below, research reactor for Italy to be built by American Machine & Foundry Company

Making Lube Oil Radioactive is part of diesel engine research at Cooper-Bessemer, and helps determine minimum run-in necessary to seat rings after an overhaul. Research also helps in selecting new metals for pistons, rings, liners

what you should know about maintaining

In an article published last month, the principles of gas regulation were discussed. This article covers what the power engineer should know about the practical side of the subject

Fig. 1. Operator removes regulator vent line before checking for dirt or gum. Vent line partially closed prevents proper handling of a quick change in flow

EASE OF MAINTENANCE is really a factor in the selection of the type of gas pressure regulator. A regulator should be chosen which, in addition to fulfilling performance requirements, offers best maintenance characteristics and therefore promise of longest useful service.

Ease of maintenance is also a factor in gas regulator installation. Regulators should be installed in convenient locations. Screw-type regulators should be installed between unions so that the regulator can be removed from the line. Dirt in the pipe line will create regulator trouble by cutting the valve seat and keeping the valves from closing off. Whenever possible the gas line should be blown before installing the regulator. In locations where continual dirt troubles are encountered, a scrubber or dirt trap should be installed ahead of the regulator.

In some locations it is necessary to maintain continual gas service. On such installations the regulator should have a by-pass line installed so that gas can be fed through the by-pass when the regulator is being repaired.

On large volume flows, particularly when the variation of flow is large, it is best to use two regulators of a smaller size to obtain flexibility. One regulator is set for slightly lower outlet pressure and will control the pressure up to flows approaching its capacity. The second regulator will start feeding when the total flow becomes relatively high.

When it is necessary to make high pressure cuts, two or more regulators should be connected in series. This type of installation insures safer operation and minimizes trouble from regulators freezing. When reducing pressures down to low pressure it is common practice to use one regulator when the maximum inlet or supply pressure does not exceed 50 psi. With inlet pressures between 50 psi and 200 psi, two regulators are used. For inlet pressures above 200 psi, three regulators are used in series.

Piping on the outlet of the regulator should be as simplified as possible so as to eliminate pressure loss through the fittings. Too many turns in the outlet piping will reduce pressure, causing pressure loss and therefore defeating the purpose of the regulator.

After installation, all regulators should be turned into service by first opening the outlet valve and then *slowly* opening the inlet valve.

General Inspection

Definite inspection and repair program for regulators is the best way to insure safe gas operation and the minimum amount of service calls due to erratic pressure conditions. The size and load characteristics of a regulator determine the amount of inspection and care which it should get. For small regulators, maintenance may be set up on the same basis as for meters. The regulator should be brought in for a complete overhaul and test at the same time the meter is brought in for routine test. It is usually not necessary to have any routine inspection period on small regulators used on combustion work. In this case, performance is observed daily, either by means of pressure gages or in noting the operation of the combustion chamber.

Most important maintenance program occurs with large regulators used at the main regulator station or metering house supplying gas to the plant. Basically, continuous inspection should be obtained by daily or weekly inspection of pressure recorded charts taken near the outlet of the regulator. There should be enough recording pressure gages in operation to obtain a true picture of the operation of all large capacity regulators.

It will be helpful to the power engineer to have a knowledge of some of the factors which can cause variation in the outlet pressure of gas regulators.

Causes of Pressure Variations

1. *Sluggish regulator.* Dirt or gum may have accumulated on the valve or around the diaphragm stem where it enters the lower diaphragm case. Such a condition will cause erratic regulation; that is, the absolute value of the outlet pressure is not directly related to the load conditions, but a decreasing flow will cause the outlet to increase temporarily and may again hold the pressure to the correct value after the flow has steadied out. Cleaning the valves, pivot bearings and all connections between the valves and regulator will usually fix this type of regulator.

2. *Vent or control piping partially closed.* Such a condition will make the regulator respond like the dirty or sluggish regulator described above. With the vent or control line partially closed a quick change in flow rate through the regulator cannot be handled properly, causing a temporary deviation of the outlet pressure. This condition may allow a regulator to perform in an entirely satisfactory manner as long as the

Gas Pressure Regulators

By HOWARD J. EVANS *

Fig. 2. Regulator diaphragm is inspected for holes and stiffness. Latter is sign that diaphragm should be re-oiled or replaced. Regular inspection is a must

flow rate changes only very slowly.

3. *Control line improperly installed.* If the control point is taken ahead of line restrictions, such as pipe elbows, the regulator may perform entirely satisfactorily and still the pressure recording gage on the main line will show excessive pressure drop at high flows. This condition is easily corrected by taking the control line down to the main line.

4. *Incorrect regulator size.* The regulator may be operating at flow rates beyond its capacity. This is indicated by a drop-off in outlet pressure during high rates of flow On a weight-type regulator it is easy to tell if the valves are wide open. If they are, the regulator is trying to operate beyond its capacity.

5. *Wrong type of regulator.* If extremely accurate pressure control is desired, the power pilot system or a pilot control system should be used. A spring or weight-type regulator cannot hold an absolutely constant operating pressure over a wide range of flows.

6. *Diaphragm case.* On large regulators the case size varies with the range of outlet pressure. The larger the diaphragm case, the more accurate the pressure control. In some cases it is better to over-range the recommended outlet pressure slightly, than to use the next smaller case. This is particularly true if, during most of the year, the larger case size will take care of desired range of outlet pressures.

7. *Inlet pressure variation.* Changes in inlet pressure do not change the outlet pressure appreciably on a balanced valve regulator unless this change is also combined with a large change in flow rate which requires the regulator to open wider. There is some effect of inlet pressure change on pilot-loaded regulators but this is not generally noted except on low outlet pressures. If this does occur, another pilot regulator can be placed ahead of the main pilot regulator so as to maintain a constant pressure to the pilot-loading system.

8. *Sudden load changes.* In some cases the erratic outlet pressure can be traced to a load change which may be a large percentage of the total load. If such a load is quickly turned off or on, it may change the pressure in the line faster than the regulator can respond. The less line capacity between the regulator and the load, the more pronounced will be the pressure fluctuation.

9. *Diaphragm stiffness.* A later diaphragm may become too stiff to respond correctly to pressure variations in the diaphragm case. The diaphragm should be re-oiled or replaced. There has been a great deal of progress in rubber-coated cloth-inserted diaphragms during the past few years. Many older regulators are using excessively thick diaphragms which can be replaced by thinner and more flexible material having greater strength.

Pressure Increase at Low Flows

Soft seat valves in regulators will shut off the flow completely after an initial build-up of pressure. A hard seat valve will control pressures down to small flows without an appreciable increase in pressure, but will not control pressure at zero flow. The following list indicates some of the main causes for a regulator allowing an excessive increase in outlet pressure at low flows.

1. *Foreign particles on the valve seat.* If dirt collects on the valves and seat, the diaphragm cannot exert enough force to close the valves. It is necessary to clean the valve seats and valve discs. If soft seat construction is being used, the soft seat valves may have dirt imbedded to such an extent that the valves will have to be replaced. Metal to metal, or hard seats, may have become dented and have to be reground.

Fig. 3. Tightening regulator control line after inspection. Note that control line is downstream from regulator

2. *Incorrect valve adjustment.* The distance between the valves may be incorrectly adjusted and have to be reset correctly so that both valves come in contact at the same time. A soft seat valve may have been clamped too tight and deformed the seating surface.

3. *Seepage of gas through leather valves.* Leather valves are treated with a beeswax and oil solution so they will not be porous. Continued operation may dry out the leather and allow gas to leak past the valves. Such valve pads should be removed from the regulator and replaced or reconditioned.

4. *Misalignment of the valves and valve seats.* The valves may be stuck near the closed position due to a bent

* Chief engineer, Rockwell Manufacturing Co.

valve stem. The valve stem should be replaced.

5. *Incorrect linkage* in low pressure balanced valve regulator. With the wrong linkage used, the linkage may be mechanically stopped before the valves contact their seats.

6. *Power pilot-loaded regulators.* In the power pilot-loaded regulators with the bleed back to the outlet line, the only force needed to close the valves is the spring underneath the main diaphragm. When the regulator closes, the pressure across the diaphragm becomes equalized so that an increase in outlet pressure does not change the force closing the valve. The size of the spring selected is kept as light as possible because the higher the force the more inlet pressure is required to operate the regulator. When springs other than standard are used, complete shut-off cannot be accomplished. There will not be a complete "lock-up" of the valves.

Regulator Pulsation

Pulsation or hunting in a regulator is quite often very difficult to overcome. This type of trouble is caused by the type of system which the regulator is feeding as well as the characteristics of the regulator. It is important not to confuse pulsation with the vibration since entirely different methods must be used to overcome these two difficulties. On pulsation or hunting, the valve stem is actually traveling up and down and opening and closing the valves. The period of pulsation may be from one to thirty seconds. This type of pulsation will be definitely recorded on a pressure gage.

A regulator which maintains a constant outlet pressure, such as a pilot-loaded regulator or pilot control, is more likely to pulsate than a spring- or weight-type. There is no doubt that the weight of the moving parts also has something to do with the magnitude of the pulsation.

In general, a regulator which pulsates is not responding fast enough to the flow changes, either due to slight binds in the regulator or the volume of the line which the regulator is feeding. Another important fact — the regulator which is too large for the load is more likely to pulsate than a properly-sized regulator.

On a simple direct spring or weight-loaded regulator, the diaphragm vent size should be increased so that the diaphragm can move faster. Any mechanical binds should be removed so that no friction retards the movement of the diaphragm, linkages or valves. A flexible diaphragm will help.

Connection between the lower diaphragm case and the outlet line should be as short as possible with no restrictions. In some cases the regulator is feeding into an oversize gas line which has too much capacity. It may be possible to eliminate pulsation by installing a restriction in the outlet line between the regulator control point and the header or oversize line. This restriction should not be sufficient to create an appreciable pressure drop even when the installation is operating at capacity flow. The restriction acts as a buffer which may break up the pulsation.

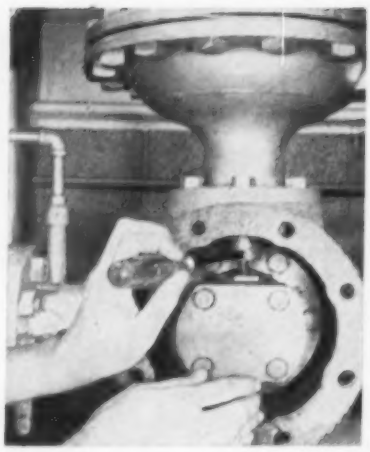


Fig. 4. Adjusting valve of high pressure balanced valve regulator. Note that regulator has been installed to be easily accessible for maintenance

On a power pilot-loaded regulator it is very important that there is no mechanical friction in the regulator because this causes the control pressure to over-correct and start the pumping or surging. Quite often it is possible to use smaller valve sizes which will still handle the maximum flow and not pump at low flows. An extra heavy spring in the pilot regulator will slightly decrease the sensitivity of the regulator and help the pumping condition. The toggles in the pilot regulator can be adjusted so that with very little movement of the pilot regulator diaphragm the pilot valve will be closed.

In some cases the pulsation is caused entirely by the location of the control point. It is best to try different locations for this point.

Regulators installed in a parallel arrangement may buck each other and seem to indicate a pulsation. This can usually be corrected by setting one regulator slightly higher than the other so that both regulators are not operating except during high rates of flow. The characteristics of one regulator can be changed by using a spring underneath its main diaphragm. This should not be done to both regulators.

Regulator Vibration

Vibrating regulator is caused by a very rapid movement of the valve, which results in a definitely noisy regulator. This vibration is harmful since it can loosen regulator parts and cause fatigue, resulting in a mechanical breakdown. Usually a vibrating regulator does not cause a variation in the outlet pressure.

The most usual cause for vibration is too much freedom of movement of the valves, without the diaphragm moving. There can be wear in the coupling block between the diaphragm stem and the valve stem. Excess wear on the valve guides will allow side motion which again can set up a vibration. The first thing that should be tried is replacing or repairing all the worn parts.

In many cases, a vibration can be stopped by applying friction of the diaphragm stem. For this reason, repacking or tightening a stuffing box will temporarily eliminate vibration, but usually the regulator will again vibrate after a short time. A special design of dash pot or constant friction device will eliminate vibration more or less permanently.

Since a dampening action will stop vibration, the use of a heavier diaphragm will often be sufficient.

A restriction in the control line between the lower diaphragm case and the outlet line will also eliminate vibration in the regulator.

A regulator is much more likely to vibrate on small flows when the valve is operating very close to its seat. The use of a smaller size regulator will often eliminate the difficulty. In cases where the regulator size cannot be reduced due to large range of flow rates, V-port valve guides on parabolic valves will help.

Regulator Freezing

Freezing of regulators depends on the amount of moisture in the gas, the pressure of the gas, the amount of pressure drop caused by the regulator, and the temperature of the gas. Hydrates will form at temperatures well above 32 F if the pressure is high enough.

On small regulators, temporary relief from freezing can be accomplished ahead of the regulator. Correct housing of small regulators will also protect them from freezing during most weather.

The best method of controlling freezing trouble is to dehydrate the gas. This can be accomplished by the following methods:

1. Absorption-type dehydrator using ethylene glycol as the medium. Usually a separator is used on the outlet to remove any of the glycol which is carried out with the gas.

2. A dry-type dehydrator using something like activated alumina to remove the moisture.

3. Using refrigeration to remove the water vapor.

Heaters can be used directly ahead of each regulator station to heat the gas above the freezing point. There are three types of heaters used — hot water, steam, and indirect flame jacket.

If there is only a slight tendency toward freezing, the use of two regulators in series will be less likely to freeze than the use of one regulator to make the complete pressure drop. The use of heating elements in pilot regulators is quite successful, since there is only a small volume of gas passing through the pilot regulator.

Fig. 1. General view of tube plant, shows piercing mill in foreground

It's automatic, from furnace to final inspection; capacity 225,000 tons a year; obtains 22,000 kw from utility to operate it

First Seamless Tube Plant in Canada

MANNESMANN TUBE Company, Ltd. has opened Canada's first seamless tube plant, for the production of pipe used largely in the oil and gas industry. The rapidly expanding Canadian market for such pipe will absorb a large part of the plant's output, which will ultimately reach 225,000 tons per year. The plant is located in Sault Sainte Marie, Ontario, — and for very definite reasons. It will receive all of its steel billets from its next door neighbor, and associate, the Algoma Steel Corp., Ltd. In fact, the two plants are so close together that the billets will be transported by straddle-trucks, thus reducing the cost of materials-handling to a minimum.

POWER ENGINEERING editors were invited to attend the opening of this $20,000,000 "plug mill" pipe plant, and witnessed the full scale operation of a mill which is operated almost entirely by electrical and mechanical automation.

As to utilities, the plant receives its 22,000 kw of power from a steam turbine plant of the Great Lakes Power Co., Ltd, which is located some 90 miles to the north. Gas from the Algoma plant heats the billet furnace; and, of course, water is no problem at Sault Ste. Marie. The main piercing mill is driven by a 4000-hp motor; the plug mill requires two-2250-hp drive motors, and the reelers employ two driven rolls — each of 400 hp.

General engineering and overall coordination of the project was carried out by the Mannesmann-Meer Engineering and Construction Co., Inc., Easton, Pa. While practically all of the mill equipment was built by Mannesmann-Meer, in West Germany, the electronic control system was developed and installed by General Electric of Canada. The Rotary Hearth furnace was supplied by Salem Engineering Co., Ltd.

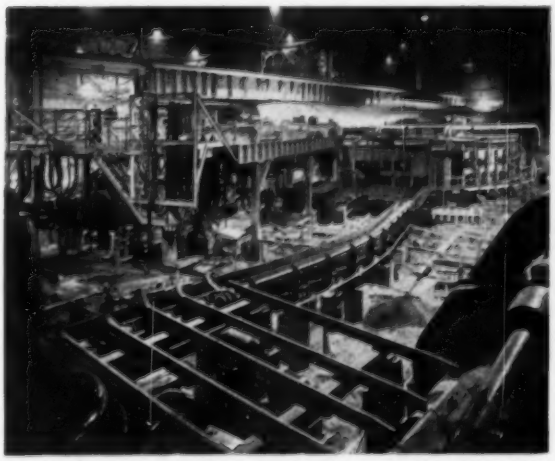


Fig. 2. Rotary hearth furnace, and conveyor to piercing mill, prior to completion of plant. Fully automatic operation loads furnace and starts billets through plant, ¼ mile long

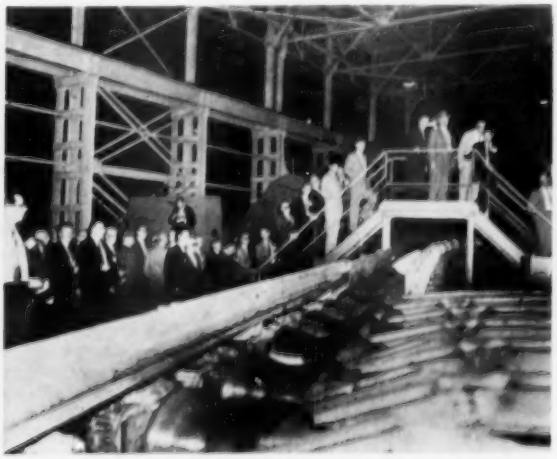


Fig. 3. Power engineers on inspection tour of Mannesmann Tube Co, Ltd plant. Group included Associate Editors McCaw, POWER ENGINEERING and Skubik, *Plant Engineering*

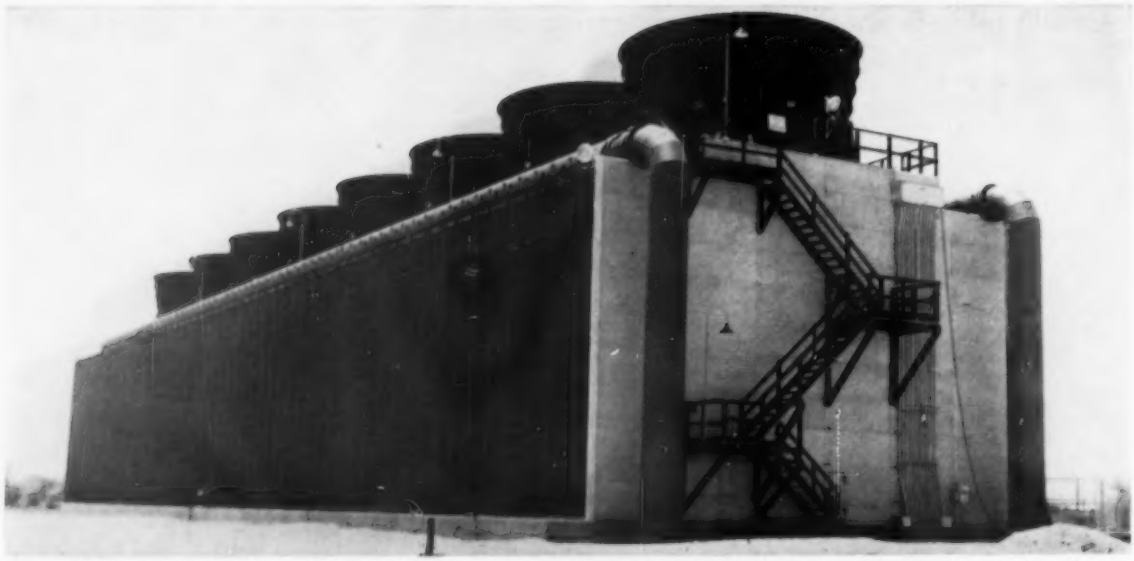


Fig. 1. Cooling towers made by Marley Co use venturi stack sections to increase velocity of discharged air, force vapor higher into the air. Towers should be located where water vapor will not create ice hazards to high-tension lines and substations

Once thought impractical,

King-Size Cooling Towers Today

By JOHN M. DRABELLE, M.E.

FOR MANY YEARS, cooling towers were limited in size and number, and were generally confined to the service of cooling process water or water used in conjunction with small generating stations and air conditioning installations. Then, as water conservation came so forcefully into the public eye, engineers began designing bigger and better cooling towers, and applying them to uses which were previously thought completely impractical or uneconomical. Also, as industry decentralized, the lack of abundant water supplies forced the consideration of cooling towers in many instances.

In the beginning, the towers were usually of the natural draft type, but gradually the mechanical draft type became a necessity, and great strides were made in its design and promotion. The tremendous need for cooling water in industry today has created the demand for king-size towers; and with them has come the need for fans and motors capable of handling the large volume of air required in the cooling process. This in turn increased the cost of "auxiliary" power, and created another problem — one of operating economy.

While American manufacturers were concentrating on improving the efficiency of the mechanical draft towers, French engineers had not given up the idea of using natural draft in their designs. They have developed a natural draft tower which makes use of a tall concrete stack in which a venturi section has been incorporated. Such towers range in height from 200 to 300 feet, which contributes two factors to the design: it gives sufficient length of stack to produce the desired draft effect, and carries the attendant evaporating water vapor high above the surrounding structures. This latter factor eliminates the public (and operating) nuisances of fog, vapor and ice. Figure 5 on page 72 shows a typical cooling tower of this type.

In the last ten years cooling towers have been applied to electric generating plants in many locations. These have been quite successful, and appear to be a good solution to the cooling water problem in those locations where abundant supplies of natural water do not prevail. In such instances, the common practice has been to impound the water of a relatively small stream by means of a low-head dam, and to use this water as a source of make-up water for the cooling tower installation. Figure 3 shows a schematic diagram of such an installation.

It will be noted that the condenser cooling water is circulated through the cooling tower, and that the lake water is used as make-up to offset the evaporation from the tower. Also, when the tower is to be taken out of service for any reason, bypass piping is provided to permit a direct feed of cooling water from the lake; and to prevent raising the temperature of the impounded water in the lake, any discharge water from the plant is taken to some point downstream from the dam which forms the lake. In one relatively new midwestern generating station, this typical cooling tower installation is supplemented by a separate water line and pump which provides make-up water *to the lake*, from another stream source, when conditions warrant.

Pre-Installation Study

An engineering study prior to the actual design of a generating plant cooling tower installation necessarily involves many factors not common to a conventional tower design. First, a complete study must be made of the stream to be impounded; stream flow records must be obtained from existing data, or measurements must be taken; chemical and biological analyses of the water must be made, and topographic surveys, to determine volume of water, dam height, land inundated, and so on. The Cooling Tower Institute, U. S. Geological Survey, Corps of Engineers, and State Conservation Departments are all sources of information which should be contacted for design data.

An example of the results compiled,

Fig. 2. Cooling tower used to supplement normal stream flow, operated by Peoples Gas & Electric Co, of Mason City, Iowa

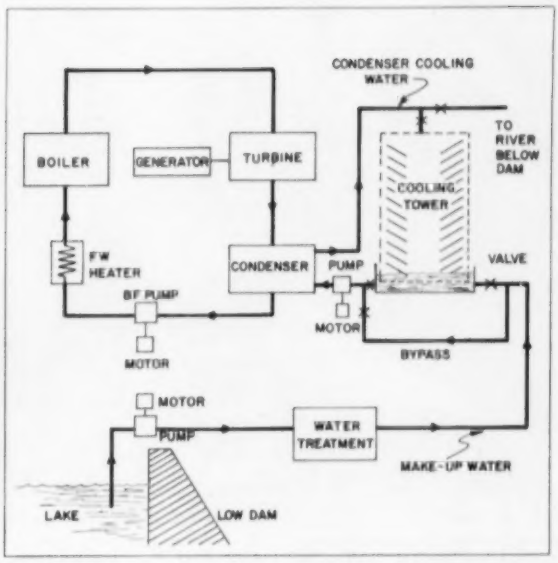


Fig. 3. Schematic showing typical cooling tower installation for generating station. Water is impounded by low-head dam

Serve Steam Generating Stations

after a complete stream flow analysis had been made, is shown in the table. This survey was made by the Stanley Engineering Co of Muscatine, Iowa, for the Corn Belt Power Coöp at their Humboldt plant on the Des Moines River. In this case, data were needed to determine whether the stream flow of the river was sufficient to serve the year-round cooling needs of the plant. The installed station capacity of this plant is 50,000 kw, at 650 psig, and temperature of 825 F; the cooling water requirements amount to 45,000 gpm.

In this case, it can be seen that the river would supply sufficient water for about 95 per cent of the total year. Since cooling towers are used here to furnish only supplementary cooling, cooling tower fan power requisites are kept to a minimum, thus contributing to station economy.

An exhaustive investigation by the Cooling Tower Institute discloses the fact that approximately one per cent of the cooling effect in towers is by *convection* of heat — from the cooling water to the air-stream; the balance is accomplished strictly by evaporation. A significant fact about cooling tower design is that according to the author's data, one lb of water will be evaporated in the tower for each lb of steam condensed in the steam cycle.

Another interesting comment is that the higher the temperature and pressure of the plant, the lower will be the quantity of cooling water required. For example, the average 30,000 kw plant of the 1920's, operating at 500 psi and 650 F, required about $1\frac{1}{4}$ gpm per kw. Now, the below-critical plants of about 250,000 kw, with reheat and regenerating cycle, have a demand of approximately $\frac{7}{10}$ gpm per kw. Also, today's supercritical pressure plants, with reheat and regenerative cycle, have a requirement of less than one-half gpm per kw of capacity.

Practical Design Factors

A few practical design features which should be considered in cooling tower engineering are these:

1. The prevailing wind direction, at the plant site, should be taken into account. The tower should be located where the water vapor will not create ice hazards to the plant and equipment, especially the high-tension lines and substations. (The Marley Company has made use of a venturi stack section on their cooling towers, to increase the velocity of the discharged air and thereby force the vapor higher into the outside air, see Fig. 1.)

2. Care should be taken with regard to ease of lubrication, inspection, and maintenance of the fan, motor, and driving gear. Particular attention should be given to the flexible couplings employed, to avoid unnecessary mechanical strains.

3. Some type of device should be provided to stop the driving motor, and sound an alarm, in case a fan blade breaks. Apparently, this type of failure is not uncommon in cooling tower operation, and considerable damage can result if an unbalanced fan is allowed to run for any length of time.

4. A disconnect switch should be installed for (and near) each of the fan motors. This will permit maintenance work to be performed on the motor and fan equipment with complete safety to the employee.

5. In cold climates, ice will build up on the cooling tower filler strips. The most practical method of removing this ice is to reverse the direction

Tabulation of research on stream flow

STREAM FLOW DATA—DES MOINES RIVER			
Flow	Flow	Per cent of time flow exceeded given discharge	
cfs	gpm	A	B
40	17,960	100.0	100.0
60	26,940	98.9	99.9
80	35,920	96.6	98.6
100	44,900	94.7	97.6
150	67,350	88.0	95.9
200	89,800	83.3	92.2

Note:
Column A shows flow duration for entire year.
Column B shows flow duration for months of April–Sept.

Fig. 4. Another application in Iowa of the big cooling tower idea is this unit used by the Cornbelt Power Coöp at the generating station located at Humboldt

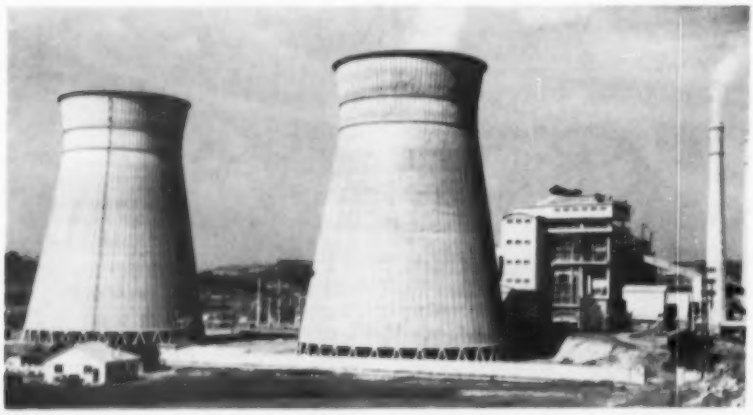


Fig. 5. Used for many years in Europe, concrete cooling towers of the atmospheric type, like these built by Hamon S. A. of Paris and Brussels, do not use fans, avoid fire danger. This photo is by courtesy of Paul Rogers & Associates

of air flow, so that the heat load of the cooling water will be directed downward into the ice build-up. To accomplish this, the direction of the motor rotation must be reversed. While this in itself is no problem, extreme care must be exercised to prevent reversal of the motor until the fan has come to a complete stop. A centrifugal switch can be installed in such a manner that it will prevent re-energizing of the motor circuit until the fan has come to a dead stop.

6. The basin of the cooling tower should be so designed that all sludge (from dust and chemical water treatment) will be slowly carried to a central sump, where it can be slushed out, or removed with a sludge pump if necessary.

These are just a few of the practical pointers gained through many years of experience with cooling tower operation.

Chemical and Biological Aspects

Certain requisites apply to the water used in a cooling tower system; some are common to all cooling water usage in a generating plant, while others are specifically applicable to cooling towers. In general, this water must satisfy all of these conditions:

1. It shall not corrode or attack the metal in the system of piping, valves, fittings, and heat exchangers.
2. It shall not deposit scale in heat exchanging equipment.
3. It shall not cause any biological attack on the wood members of the tower structure.
4. It shall be of such chemical composition that it will not cause any chemical attack on the wood structural members of the tower.

Importance of the above requirements can be realized when certain basic facts are known.

It has been learned that there is an evaporation rate of approximately one per cent in water volume for each 10 deg drop in water temperature through the tower. For example, if the cooling tower is handling 1000 gpm of cooling water, there will be a loss from evaporation of 10 gpm. This adds up to 600 gph, or 14,400 gal per day. This means that for every 1000 gpm used in the actual cooling process, 14,400 gpm must be treated so that no chemical or biological damage will be done to the tower and piping system.

In addition to the evaporation losses, an additional quantity of make-up water must be supplied to keep the concentration of solids dissolved in the water to acceptable limits. This ratio is about 3 to 4 gal of make-up water to every gallon lost through evaporation. Adding this volume of water to the actual process water, plus the evaporation loss, we find that it amounts to about 1,512,000 gal per day — for every 1000 gpm used for process. From these figures it can readily be seen that even a slight excess in corrosive elements in the water can create great damage to the tower.

Considerable research has been done in recent years by the Cooling Tower Institute and the Edison Electric Institute on the subject of wood-member failures in cooling towers. The CTI has summarized its findings to date in Bulletin CTI-WMS-104; apparently there are four fairly reliable wood preservatives worthy of attention.

Chlorine has been used to prevent slime formation due to algae growth; however, this treatment can cause wood deterioration under certain conditions. If chlorine concentration reaches a value of 1 ppm in the pH range of 9.0, the rate of wood deterioration increases rapidly. However, if this same concentration of chlorine exists in a pH value between 7.25 and 7.50, the wood wasting is kept at a minimum, as is biological growth.

Chemical attack on wood cooling towers is charged generally to high concentrations of sodium carbonate, which results in a phenomenon known as "delignification." This action, combined with operating temperatures of approximately 120 F, serves to accelerate the chemical decomposition of the wood. In practice, small amounts of sulphuric acid are added to the water to convert the carbonates (or bicarbonates) into sulphates, thereby reducing the delignification to a minimum. Generally speaking, a pH of 6.9 to 7.1 should be maintained as an optimum.

In addition to the usual mechanical and electrical maintenance techniques, cooling towers must receive adequate and competent chemical analysis and treatment, on a constant routine basis.

Which is which, and what are the advantages and disadvantages of each?

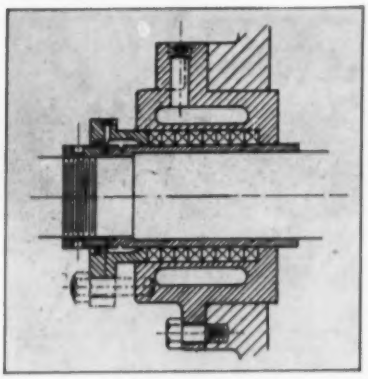


Fig. 1. Conventional or standard water-jacketed stuffing box is most common

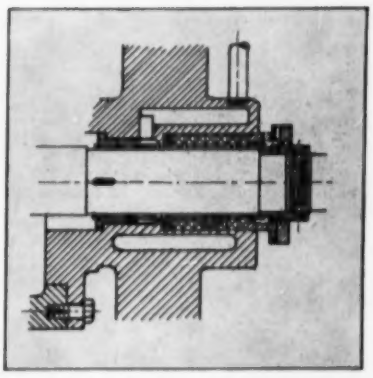


Fig. 2. Box with take-off to heater has same jacket and gland as does standard

5 Kinds of Stuffing Boxes for Barrel-Type B-F Pumps

By M. W. LUTZ*

DESIGN AND maintenance of stuffing boxes, particularly in boiler feed pumps, has long been a problem for pump manufacturers as well as for central station operators. The wide range of suction conditions up to 500 psi, speeds up to 9000 rpm or higher, and temperatures above 400 F make the choice of the correct type of stuffing box very important. A knowledge of the merits or disadvantages of each type of stuffing box will permit a more intelligent selection of the proper type.

Figure 3 shows an assembly section of a modern high pressure barrel-type boiler feed pump. Barrel pump designs by various manufacturers may differ. The pump in Fig. 3 has single suction impellers opposed to obtain axial balance. Other designs may have all single suction impellers arranged in series with a balance drum. Although the designs are different, the stuffing box problems are common to all. The high pressure or discharge end stuffing box must be considered separately from the suction end stuffing box. The additional first stage pressure on the discharge end stuffing box makes the design more complex than for the suction end type.

The types of stuffing boxes are: 1. standard packing; 2. pressure take off; 3. condensate seal; 4. packingless seal; and 5. mechanical seal.

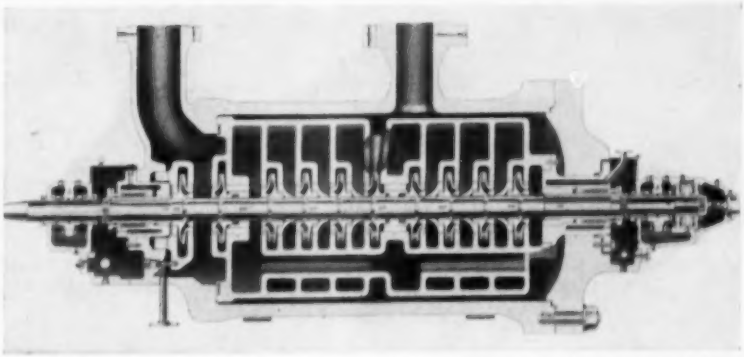


Fig. 3. Although designs for barrel-type b-f pumps vary, the stuffing box problems are common to all. This is a modern high pressure 9-stage barrel-type b-f pump

Standard Box

The most common type of stuffing box is the standard or conventional (Fig. 1). The suction end stuffing box has from seven to eight rings of metallic packing to seal pressures at a maximum of 150 to 175 psi. The high pressure end stuffing box has a breakdown serrated bushing ahead of the packing to reduce pressure to acceptable packing limits. The leakage is generally returned to the suction chamber by means of a return pipe or may be bled off to the deaerator. Water-cooled jackets are designed into the stuffing boxes to increase packing life.

Stuffing glands quench hot vapors that may result from worn packing and also keep the pump looking presentable by preventing corrosion around the stuffing boxes. Glands of this type require only about ¼ to ½ gpm of cooling water and are a desirable asset. Maximum temperatures encountered are from 350 F to 400 F. At the higher temperatures, about 2 gpm of cooling water per box are required. At temperatures of 200 F to 250 F this quantity may be reduced to about 1 gpm.

Pressures up to 260 to 275 psi have been successfully packed; however, careful breaking in of the packing, and continuous operator control and inspection are required. Packing life under these conditions will vary greatly depending upon the know-how of the operator and may be from a month or less up to six months. Life of the packing at 150 psi may be as long as one to two years.

Proper installation of each ring of packing is essential for the longest life. All rings must be firmly pressed to the bottom of the box, with butt joints staggered to prevent the forming of an improper leakage path. Upon start-up, if the new packing becomes too hot, the pump should be shut down for a short time. One or two shut-downs are generally enough to adjust the packing for proper operation.

When the final ring has been firmly and solidly pulled up by means of the gland, the gland nuts must be backed off until they are only finger tight. A small amount of leakage un-

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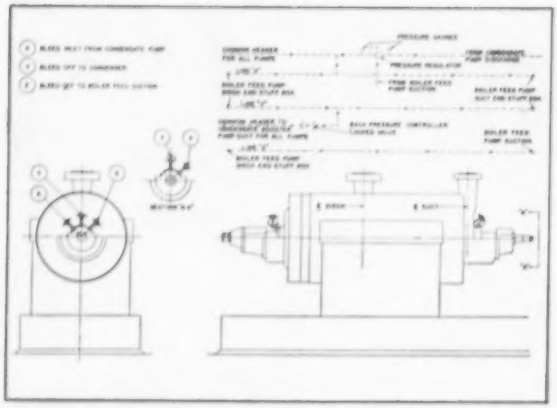

Fig. 4. Schematic piping diagram for condensate sealing arrangement for stuffing boxes. Z is bleed-off, discharge end

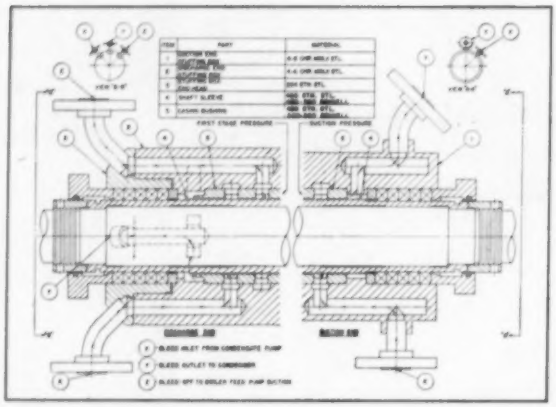

Fig. 5. Showing construction for both suction and discharge ends. Condensate is returned by line Y to the condenser

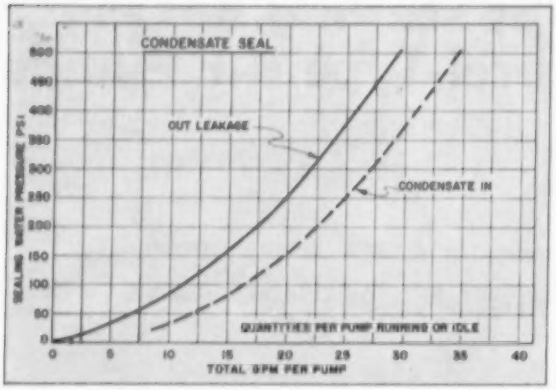

Fig. 6. This graph and the one in Fig. 7 show quantity of condensate in, and leakage out, of two sizes of pumps

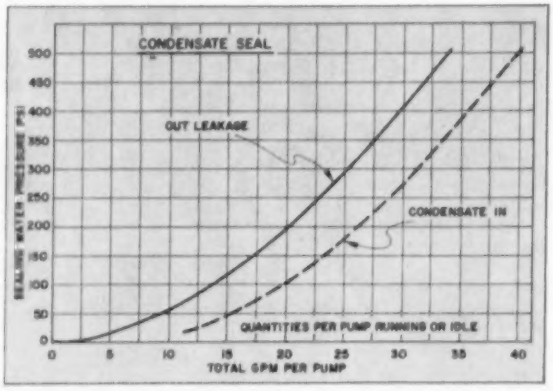

Fig. 7. These curves and those of Fig. 6 were plotted from actual field test data. Condensate seal has many advantages

der the packing is necessary for lubrication and will prolong the life of the hardened 12 to 14 per cent chrome stainless steel packing sleeve. The amount of drip may be quite small, of less than one pint a minute, until it increases to more than 1 gpm when it is necessary to replace or adjust the packing.

For best results, gland adjustment to reduce leakage should be made with the pump idle; a turn of one flat of the hexagonal gland nut in 15 minutes should be the maximum rate of take-up.

Pressure Take-Off

Suction pressure may be as high as 500 psi when using a closed system on the suction side of a boiler feed pump. The condensate pump discharge goes through a series of closed intermediate heaters before reaching the feed pump. Pressures this high are necessary to prevent flashing at temperatures of 350 F to 400 F. Under all load conditions the pump must be protected and be insured a continuous and absolutely reliable quantity of feedwater to the suction at sufficient pressure.

Both the suction end and high pressure end stuffing boxes are designed with a breakdown bushing to reduce the amount of leakage and decrease the pressure on the packing. The leakage is bled off to an intermediate low pressure heater. The heater pressure should be less than 150 psi to insure a good packing life and ease of maintenance. As the leakage is directly charged to pump efficiency, the proper length of bushing with minimum running clearances must be used. Diametral clearances are about 0.000 in. to 0.012 in.

Serrated bushings with sharp-edged contractions and enlargements show a reduction in leakage of up to 35 per cent over that of plain or straight bushings. For longer operation and fewer pump shut-downs, replacement materials are of the best quality. Shaft sleeves and bushings are of 12 to 14 per cent chrome stainless steel hardened 350 to 500 Brinell. In some instances Colmonoy or Stellite on a 300 series stainless steel base may be preferred. Figure 2 shows a stuffing box with take-off to heater.

For example, a 600,000 lb per hr pump at 350 F and 250 psi suction may have a total leakage of 22 gpm at full load. Due to the increased head of the condensate pump at low load conditions, the leakage may increase to 30 gpm. In the initial plant system layout the heater drain pumps will be selected to handle the leakage. After five years of operation the bushing clearances may open up enough to double the amount of leakage. (Diametral clearances need only to increase from 0.010 in. initially to 0.016 in. to double the leakage.) Heater drain pumps should be selected to handle at least double the initial leakage, and also to handle the leakage of the idle pump, which is approximately the same as the running pump.

The water-cooling jacket and quenching gland are of the same design as those of the standard-type stuffing box.

Condensate Seal

The condensate sealing arrangement for stuffing boxes has several advantages as compared to the standard type of pressure take-off type. Condensate which is relatively cool is piped to each stuffing box from the condensate discharge at a pressure slightly above suction pressure. A small amount enters the pump suc-

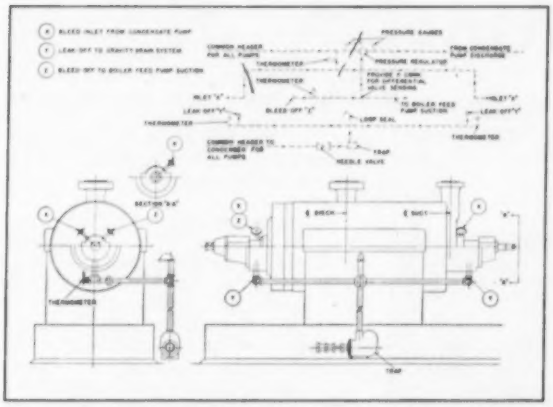

Fig. 8. Schematic piping diagram for the packingless sealing arrangement for stuffing boxes, 4th type to be considered

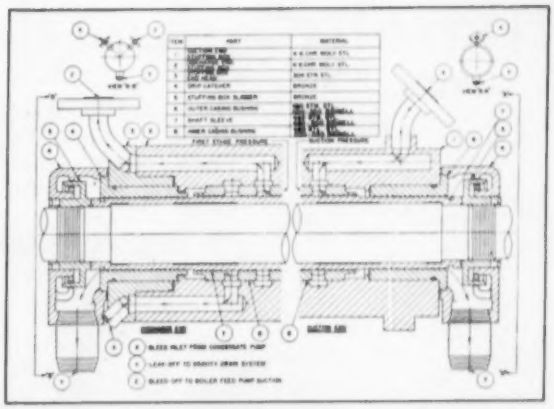

Fig. 9. Construction details for packingless seal type. Condensate in X enters inner bushing, leakage enters line Y

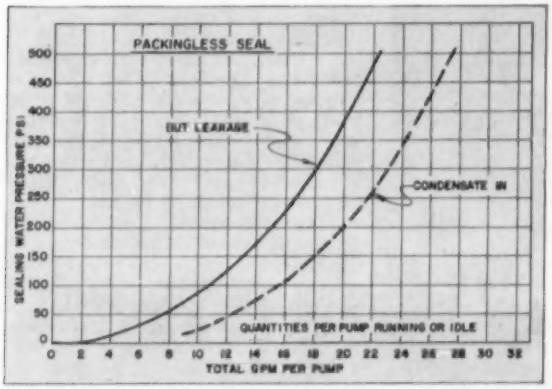

Fig. 10. These curves and those of Fig. 11 give amount of condensate entering and leaking from pumps of two sizes

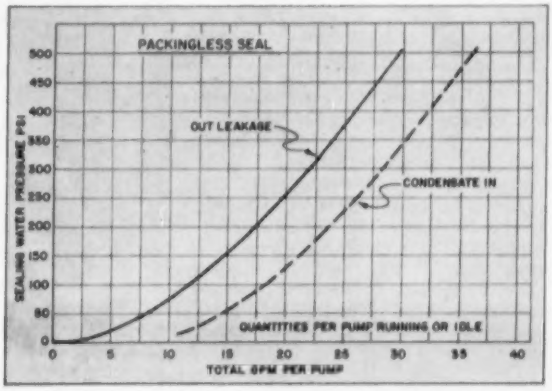

Fig. 11. Amount of leakage is about 10 to 20 per cent less than the leakage of the condensate seal system (Figs. 7–8)

tion; the remainder flows through a breakdown bushing to the base of the packing and then is bled off to the condenser hot well. Consequently the objectional high temperature and high pressure water is kept completely away from the packing.

Careful checks by means of system heat balance show that the controlled leakages result in greater economy. The condensate acts as a cooling medium and eliminates the necessity of service water for cooling jackets and quenching glands. Heater drip pump capacity is kept at the lowest possible quantity and will be kept at the same capacity for duration of the unit.

Figure 4 shows the schematic piping diagram for the condensate sealing arrangement. Condensate at approximately 100 F from the condensate pump discharge enters the suction end and discharge end stuffing boxes. This is shown by the line marked X. The condensate bleed-in is kept to a minimum by means of a pressure regulator set at 3 to 5 psi above suction pressure. The condensate flows through a breakdown bushing and then returns to the condenser. This is shown by the line marked Y. Line Z is the bleed-off from the high pressure or discharge end to the boiler feed pump suction or possibly to an intermediate heater. The arrangement shown can be applied to three half capacity or two full capacity feed pumps using a common header from the condensate discharge with one pressure regulator for the pumps.

For trouble-free operation the packing requires 25 to 50 psi back pressure. To keep the back pressure as indicated under all load conditions several devices may be installed in line Y. A locked valve throttled to about 25 to 50 psi, a pressure regulator or a calibrated orifice will work quite well. The pressure regulator and orifice will be the most foolproof for they cannot be shut off accidently as the valve may be. Typical pipe sizes are a 2-in. header from the condensate pump with 1-in. pipe to each end of the pump and 1-in. returns from both ends of the pump to a 2-in. header back to the condenser.

A number of stations have reported excellent control with a 2½-in. Fisher type-57T air-operated diaphragm control regulating valve. Condensate from the condensate pump discharge will be handled by the valve to maintain a constant differential pressure between the pump suction and the leak-off at the stuffing box. This differential will be adjustable from 1 to 5 psi by means of a controller. A Fisher 2516 receiver controller with reset and filter regulator will maintain the required differential. A Foxboro DP cell will sense the 1 to 5 psi differentials between the condensate sealing water and pump suction and provide proper impulse to the receiver controller for valve operation. In some cases, for a more rapid control of the transmission of pressure changes, a Carter inverse derivative relay has been used.

Figure 5 illustrates the construction and lists typical materials of the suction end and discharge end. At the suction end the condensate entering in line X is bled into the center of the bushing. A small quantity, 1 to 2 gpm depending on the actual load conditions, enters the pump suction passage. The remainder of the bleed-in condensate flows through the breakdown bushing toward the packing.

The condensate is collected in a

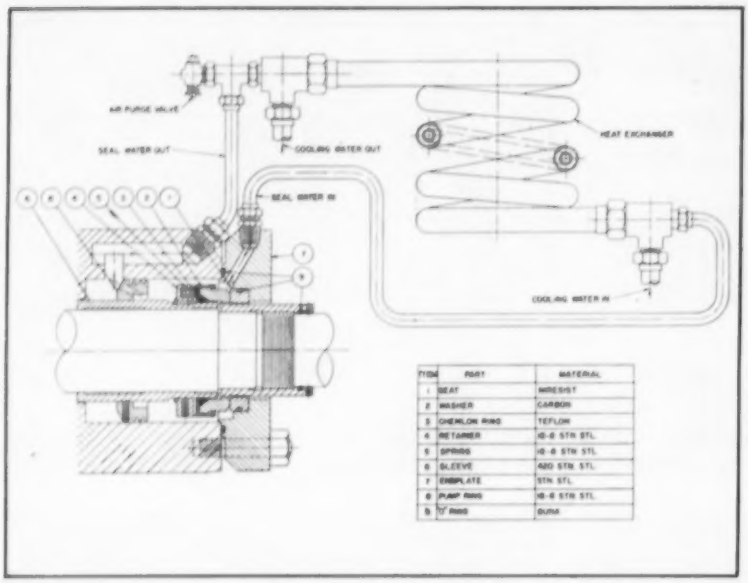

Fig. 12. Fifth type is the mechanical seal arrangement. Here a packaged seal with a pump circulating ring are hooked-up with a heat exchanger. Performance is good

chamber just before the packing and returned by line Y to the condenser. At the discharge end, the condensate X is bled into the bushing with a small quantity, 1 to 2 gpm flowing toward the collecting chamber of the first stage take-off where it mixes and is carried back to the suction or heater in line Z.

The remainder of the bleed-in condensate is collected just before the packing and returned in Y to condenser. The path of the condensate keeps the stuffing box and packing cool and eliminates the need of a cooling jacket around the packing or quenching gland. The bleed-off in Y has a rise in temperature which ranges from 5 to 10 F.

Figures 6 and 7 show the actual quantity of condensate into and leakage out of two sizes of barrel-type boiler feed pumps. The curves were plotted from actual field test data.

Under various load conditions, temperatures and quantities were taken in X, Y and Z. Quantities were measured by calibrated stainless steel plate orifices that were left in the lines for future checking. After one year's operation no appreciable increase in capacity was noted. In most cases the quantity of condensate required is less than that shown on the curves. The amount of in-leakage is from 2 to 5 gpm more than the out-leakage. The difference in quantity depends on how fine the pressure regulator holds the inlet pressure in X above the suction pressure.

The condensate seal arrangement can be advantageous to a deaerating system as well as to a closed system. Most deaerating systems will be taken care of by the standard stuffing boxes; however, when temperatures become elevated, say 350 F or more, and the suction pressure is about 150 psi, the condensate seal arrangement may be preferred because of its advantages.

Packingless Seal

The absolute minimum of maintenance or supervision by operating personnel is obtained with the packingless sealing arrangement. Without packing drip or gland steaming there is no discoloration or corrosion about the stuffing boxes; pumps look neat and bright indefinitely, just as at initial installation. All the advantages of the condensate sealing system are obtained by feed pumps with the packingless system, such as elimination of cooling water to jacket and gland and selection of smaller heater drip pumps.

Figure 8 shows the schematic piping diagram for the packingless sealing arrangement. Condensate is piped to each stuffing box through the line X. The pressure regulator keeps the bleed-in at 3 to 5 psi above suction pressure. The condensate flows through an inner and then an outer serrated bushing. A drip catcher gathers the condensate at each end of the pump and permits it to flow by gravity to a collecting trap. The condensate leakage is drawn back into the system by means of the condenser vacuum.

Upon start-up with no vacuum in the condenser, the leakage will run through an overflow pipe on to the bed plate. The overflow also keeps the leakage from backing up and entering the bearing bodies. Line Z takes the high pressure bushing leakage back to the pump suction or to a heater. A needle valve after the trap will control the flow back to the condenser.

Again, one pressure regulator will serve two or three pumps. A separate trap is recommended for each pump although in some instances a single trap has been ample for three pumps. A 2-in. header from the condensate pump discharge with 1-in. pipe to each stuffing box are suggested. Two-inch lines to the trap and then a 3-in. header to the condenser have proved effective.

Construction and suggested materials are given in Fig. 9. Condensate in X enters the inner bushings. One to 2 gpm enter the suction chamber, the remainder flows through the inner bushing and then the outer bushing to the drip catcher at atmospheric pressure. The stuffing box slinger forms an effective seal to prevent the leakage from creeping along the shaft and entering the bearings. The leakage enters line Y and drains to the collecting trap. The condensate keeps the stuffing boxes relatively cool thus insuring cooler running bearings. The temperature rise of the bleed-off Y is less than 10 F. Materials that have been used successfully are given. A number of pumps have two to three years' operation and have reported no indicated change since original installation. Recommended spare parts are shaft sleeves, inner casing bushing, and outer casing bushing.

Figures 10 and 11 give the amount of condensate entering and leaking out of the stuffing boxes with various sealing water pressures for two sizes of pumps. The amount of leakage is about 10 to 20 per cent less than the leakage of the condensate seal system. Actual field test is less than the quantities indicated by the curves. The out leakage is 2 to 6 gpm less than the condensate bled in. Quantities are approximately the same for the pump whether it is running or standing idle.

Both the condensate seal or the packingless seal systems can eliminate the pressure regulator in the line from the condensate discharge. This manner of economy is costly; the increase in the amount of condensate required will pay for the regulator in a comparatively short time. One danger to avoid is the interruption of the condensate to the stuffing boxes. Shop tests in which the sealing water was deliberately shut off proved that the pump could be run for at least eight hours without harm to the pump. With the condensate seal system it is possible that the packing may be ruined, but that is a matter of small consequence in such an emergency.

With the packingless seal system there will be steaming out of the drip catcher; however, a pipe tap connection is provided for admission of quenching water to snuff the vapors. When the packingless seal was first designed, possible oxygen contamination to the condensate system was feared. After several years of field operation no oxygen contamination has been found. Packingless seals are the only reliable *continued on page 96*

H-T H-W Controls Are Different

Although high temperature hot water systems are inherently stable, varying water flow rates, flashing and other factors require special treatment and controls must be adapted to fit different flow schemes advantageously

By R. S. DARKE *

HOT WATER for heating of homes, buildings and small plants is nothing new and its control has been simple and basic. But until a few years ago, *high temperature* hot water was relatively unknown in the United States. It is now rapidly becoming an accepted means of space and process heating in this country — for factories, housing projects, institutions and air bases. It is especially suited for distribution of heat to groups of buildings and users scattered over wide areas.

High temperature hot water systems utilize water at temperatures above 212 F by maintaining a system pressure above the saturation pressure of the water at the required temperature. Temperatures from 350 F to 450 F appear to be common for installations now being made.

The main advantages of high temperature hot water as compared with steam for district heating, are:

1. Completely closed loop system eliminates condensate traps, pressure regulators, and separators; minimizes losses of fluid, may reduce requirements for feedwater treatment and reduce maintenance costs proportionately.

2. Piping installation requires no grading and can be made at any level.

3. Reduction in size of boiler plant may be made possible by the large thermal storage of the entire system.

4. A higher system thermal efficiency is possible, reducing fuel consumption and other related costs.

It is not the purpose of this article to delve into the thermodynamics of the comparison. Suffice it to say that a study of steam tables and the basic properties of water and steam will confirm some of the statements made above. Similarly, it is not our purpose here to investigate all of the possibilities of establishing hot water systems such as adapting existing boiler equipment, using steam boilers to heat water for distribution, and other very worthwhile considerations.

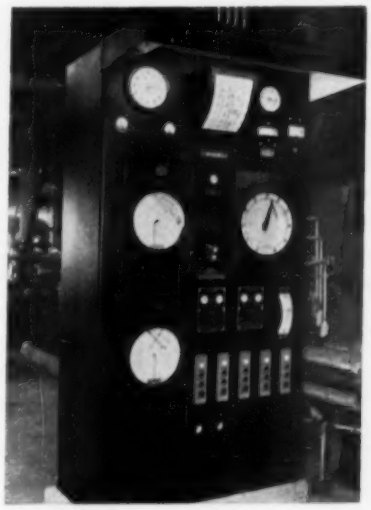

Fig. 1. Control and instrument panel for H-T H-W boiler installed at an air base

Size of plants where the economics of high temperature hot water heating becomes quite attractive makes it desirable to consider some fair sized boilers. Boiler design capacities run from 5,000,000 Btu per hour to as high as 200,000,000 Btu per hour. This covers the equivalent steam boiler range of 5000 to 200,000 lb of steam per hour. The use of instruments and controls for steam boilers is widely accepted and essential. With proper application and design, instrument and control systems for high temperature hot water boilers and heating systems can be equally effective and desirable.

To understand some of the problems in the proper application of instruments and control, it is necessary to know the features of the basic systems to which this equipment is to be applied and the problems that must be handled by it.

Types of Hot Water Systems

Expansion tanks are common to all high temperature hot water systems and provide for the expansion and contraction of the water, for storage and a means of pressurizing the systems.

There are two basic means of pressurizing high pressure high temperature hot water systems. The most common one is that of using steam in the expansion tank, the pressure of which corresponds to the saturation pressure at the temperature of the water being fed to the tank by the boilers. The alternative method is to use compressed air or inert gas to establish the pressure of the system. Because of corrosion problems, an inert gas such as nitrogen is preferred.

Use of an inert gas to pressurize the system permits the establishing of a pressure sufficiently above the saturation point to prevent vaporization of the water anywhere in the system. The use of a steam expansion tank, as in Figs. 2 and 3, requires that the tank be located physically at a point sufficiently above the system circulating pumps to prevent flashing in the pump suction. Circulating pumps supply enough pressure to prevent flashing in the distribution system. On the other hand, the inert gas system requires additional equipment such as a compressor and receivers or

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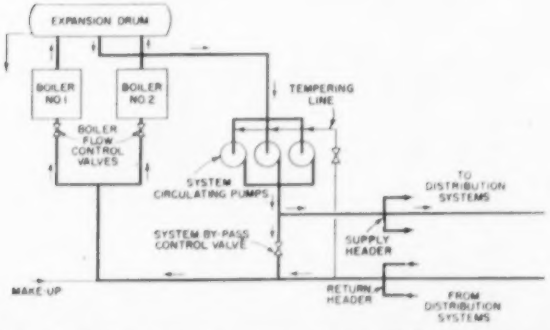


Fig. 2. Basic flow diagram, combined-pump H-T H-W system

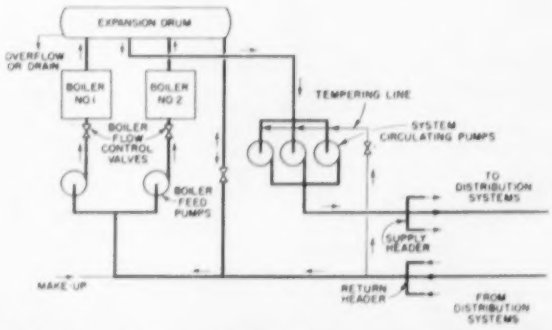


Fig. 3. Separate-pump system, advantageous in some cases

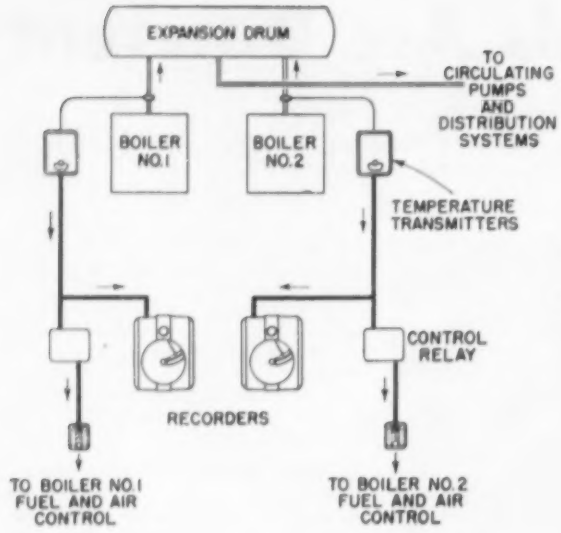


Fig. 4. Single-element master control which uses signals from boiler outlet temperature transmitters only

pressure tanks. Refer to Fig. 8.

There are two basic flow systems in use. One is the combined-pump type wherein the expansion tank, system circulating pumps, the distribution systems and the boilers are all connected in series as one continuous loop. See Fig. 2.

Changes in flow in the distribution systems as occasioned by local control of heat-using equipment or distribution branches affects the flow of water through the boilers. The system is usually arranged so that water may be taken from the circulating pump discharge and introduced into the return line to the boilers so that a minimum flow of water through the boiler may be established.

The separate-pump system can be considered as two loops with the expansion tank common to both loops. One loop consists of the expansion drum, the system circulating pumps and the distribution systems. The other loop consists of the expansion drum, the boiler circulating pumps and the boilers. This is illustrated in Fig. 3. When the flow of water through the boiler equals the flow through the distribution system, the separate pump system is, in reality, a single loop with two sets of pumps in series.

Hot water from the drum is circulated by the system pumps through the system and back to the boiler pump suction. Usually the boiler circulating pumps are constant volume pumps. Since the flow of water is maintained at a relatively constant value, adequate supply of water to the boilers is assured without auxiliary bypass provisions.

Master Control

The main object of a high temperature hot water boiler control system is to regulate the firing rate so as to maintain the water supplied to the system at a specified temperature. It would appear that since expansion drum pressure (in the steam pressurized systems) bears a definite relationship to boiler outlet temperature, it could be used as the common master control index for all boilers on the system just as it is for steam boilers. However, the temperature of the water in the expansion drum — and the corresponding pressure — is only an *average* of the water temperatures leaving each boiler.

Even though it were at the desired value, there would be no assurance that each boiler was being fired in proportion to the load it was carrying, or that the rate of heat absorption was in proportion to the load. The only real indication that a boiler is supplying its share of the load is the fact that the boiler outlet water temperature is at the desired value on the basis of equal water flow through each boiler. Therefore, the water temperature leaving each boiler should be used as the primary control index for regulating fuel and air to that boiler. Refer to Fig. 4.

Since expansion drum pressure is indicative of the average temperature, and since it is desirable to maintain it within certain limits, a single pressure impulse can be used to set the individual boiler temperature controllers and act as an override when necessary. It should be used as the secondary control function on all but the smallest and least expensively instrumented boilers and is illustrated in Fig. 5. It is not used on inert gas pressurized boilers where pressure control is a function of the gas supply system.

High temperature hot water heating systems normally have a high energy of heat storage capacity which acts as a reservoir or flywheel to stabilize the effect of load changes on the boilers. For systems such as those designed basically for continuous space heating of buildings where load changes are relatively slow and moderate, single-element (boiler outlet temperature) and two-element (boiler outlet temperature plus expansion drum pressure) systems are adequate. For larger systems where the water is used for heating machines or areas of a plant that are not in constant use or are subject to large sudden changes such as the opening of a large hangar door, a third element which anticipates the load change is essential.

When a rapid and large load increase takes place, its effect as evidenced by a drop in temperature is not felt by the boiler outlet control elements until the cooler water has already passed through the boiler. This may result in an overshooting control action unless some measure of load change is used as the primary control function to anticipate the effect of such a change on the boiler.

When the water flow through the boiler is practically constant at or near the maximum value, as in the separate pump systems, the change in return water temperature can be used as a guide to regulate the firing rate. This function, along with boiler outlet temperature and expansion drum pressure as secondary readjustments becomes a complete three-element system, which is to be preferred for all the larger boiler plants. See Fig. 6.

In any system where the water flow

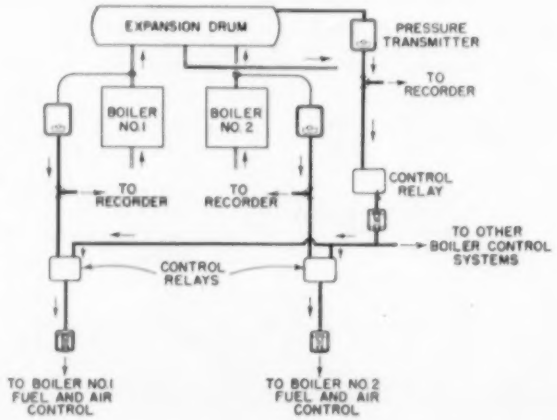


Fig. 5. Two-element master control is based on signals from expansion drum pressure plus outlet temperatures

through the boilers will vary, return temperature alone may not necessarily be a satisfactory load index. Since a load change may be indicated by a change in water flow, the two factors must be combined to provide a more accurate guide for regulating the firing rate. The boiler Btu meter can provide a control signal based on this combination. This signal can be used in a three-element control system in place of return temperature.

With steam pressurizing, steam may form in the boiler under certain conditions of operation. If this does occur, the boiler Btu meter will not be accurate. It is possible, however, that the system Btu meter may be used to provide the needed load index in that case.

In steam boiler control systems, it is frequently specified that means be included to permit the operator to bias the firing rate manually so that the division of load between the boilers can be changed. It should be pointed out that this feature cannot be included, as such, on high temperature hot water boiler systems. To change the share of the plant load which a boiler is carrying, it is necessary to change the water flow through the boiler accordingly. When and if this is done, a properly designed master control system as outlined above will automatically change the firing rate as required to maintain the boiler outlet temperature at the desired value.

Combustion Control

Combustion control — the maintaining of optimum fuel-air ratio — for high temperature hot water boilers, is quite similar to that for conventional steam boilers. Wherever it is possible to measure the flow of fuel (oil or gas, for instance) it is preferable to control fuel-air ratio on a direct metered basis. However, where the fuel flow cannot be measured as on pulverized coal or spreader stoker fired boilers, it is necessary to use an indirect measure of fuel-air ratio.

On steam boilers, steam flow is a measure of heat released in the furnace by the fuel being fired, at specified operating conditions and actual efficiencies. It is thus a measure of the rate of fuel input and the required air flow for combustion. The steam-flow — air-flow relationship of the boiler meter has long been an accepted measure of fuel-air ratio on this basis.

Under equilibrium conditions on a hot water boiler, a similar measure of heat released in the furnace, and thus the flow of fuel, can be obtained with a Btu meter. See Fig. 7. Measurements of water flow through the boiler and the temperature difference across the boiler are multiplied together, establishing an instantaneous and continuous record of net Btu delivered to the system. This measurement, related to that of air flow, can be used not only as a guide or indication of fuel-air ratio, but can also be used in a control system to readjust the forced draft damper, for instance, so as to automatically obtain the optimum fuel-air ratio.

Water Flow Control

For a combined pump system, the flow through the distribution system is the same as the flow through the boiler for normal operation. If portions of the distribution system are removed from service, heating units shut off, or the total flow reduced for any reason, the flow through the boilers will be reduced likewise. It thus becomes necessary to protect the boilers against reduction of flow be-

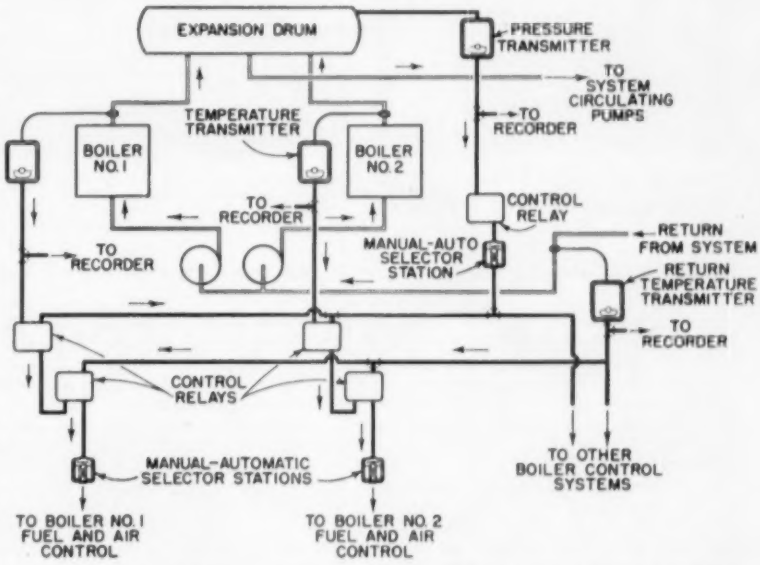


Fig. 6. Three-element master control utilizes signals from not only boiler outlet temperatures and drum pressure but also return-from-system temperature transmitter

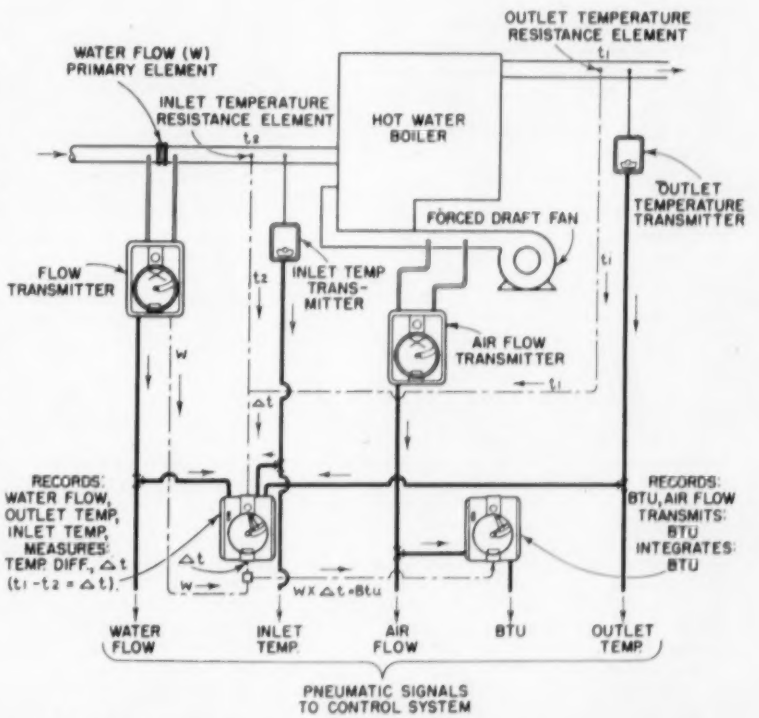

OUTLET TEMPERATURE RESISTANCE ELEMENT
WATER FLOW (W) PRIMARY ELEMENT
INLET TEMPERATURE RESISTANCE ELEMENT
HOT WATER BOILER
OUTLET TEMPERATURE TRANSMITTER
FORCED DRAFT FAN
FLOW TRANSMITTER
INLET TEMP TRANS-MITTER
AIR FLOW TRANSMITTER
RECORDS: WATER FLOW, OUTLET TEMP, INLET TEMP, MEASURES: TEMP. DIFF., Δt (t1 - t2 = Δt).
RECORDS: BTU, AIR FLOW TRANSMITS: BTU INTEGRATES: BTU
WX Δt = Btu
WATER FLOW
INLET TEMP.
AIR FLOW
BTU
OUTLET TEMP.
PNEUMATIC SIGNALS TO CONTROL SYSTEM

Fig. 7. By the addition of Btu metering to the three-element master control system it is possible to sense demand, and provide necessities for combustion control

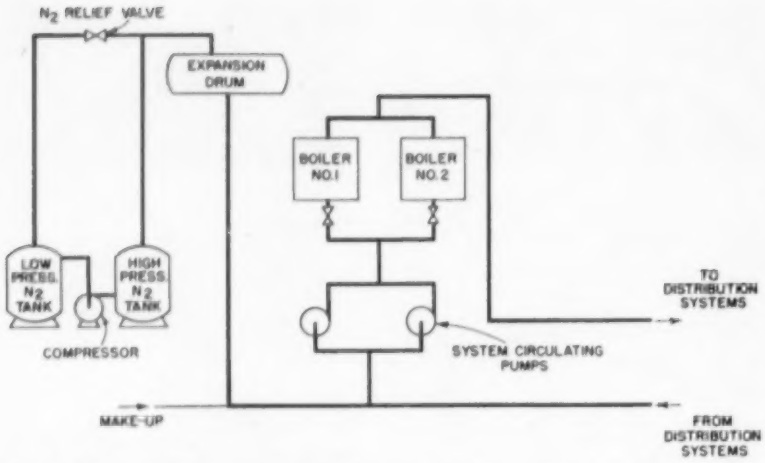


Fig. 8. Diagram showing nitrogen-pressurized high temperature hot water system

low the point considered the minimum for safe operation of the boiler. This minimum varies anywhere from approximately 20 per cent of maximum flow on up, depending upon the particular installation and the type of boiler involved.

The safest and most direct method of accomplishing this is to actually measure the water flow to each boiler and use this measurement to automatically regulate the bypass valve (in the line from the circulating pump outlet to the boiler return header, shown in Fig. 2) so as to maintain the water flow to the boiler at a predetermined minimum. Where more than one boiler is on the line, it becomes necessary to use a system of selective relays so arranged that should one boiler have a water flow lower than any other, it will be the one to establish the control signal.

There is another approach to this problem. When a portion of the distribution system is shut off, and no change has been made in the number of circulating pumps in service or in their speed, the differential pressure across the distribution system will increase. Measurement of the differential pressure can be used as an index to control the bypass valve to maintain the differential below a certain predetermined maximum.

In another type of system, the bypass control valve is regulated as required to maintain a predetermined temperature differential across the boiler. The object of such an arrangement is to protect the boiler against acid corrosion due to low metal temperature in instances where the fuel used is high in sulphur content. This control tends to reduce the water flow through the bypass at loads which would probably require increased flow to maintain minimum flow through the boiler. Under such circumstances, it is necessary to incorporate in the control system additional means of limiting the reduction of flow through the boiler.

As mentioned previously, a separate-pump system maintains a relatively constant flow of water through the boilers. No particular problem exists here except to provide protection and alarm in case the flow stops or it is reduced below a safe minimum for some reason.

Instrumentation

Concerning indications and records of boiler drafts, windbox pressures, flue gas temperatures, pulverizer pressures and temperatures, the requirements for high temperature hot water boilers are the same as they are for steam boilers. In addition to these, certain other measurements are required for hot water boiler operation.

Basically, it is necessary to know the water temperature at the outlet of each boiler. In most cases, this is an important enough factor to be recorded. Similarly, the temperature of the water being supplied to the boilers is an important factor and can be measured either at the inlet to each boiler or in the header supplying all boilers. This should be on the boiler side of any connections such as the bypass water line which might introduce water at temperatures different than that returning to the boilers.

The important pressure is that in the expansion drum. This should at least be indicated and preferably recorded. Useful guides are duplex pressure gages which can be used to measure pressures before and after each boiler and system circulating pump.

Measurement of water flow through each boiler is essential. It is highly desirable to have it indicated in the vicinity of the manual control valve at the boiler inlet. This guides the operator in setting the valves to equalize the flows through the boilers.

On the larger jobs it is desirable to have a record of the water flow through the boiler, particularly on a combined pump system where water flow through the boiler does vary. To accommodate the requirements of having an indicator at the boiler inlet and a recorder on the control panel, it is necessary to use a remote transmission system. A single recorder can be used to combine the records of water flow, outlet water temperature and inlet water temperature on a single chart to provide a complete record of boiler performance. Refer to Fig. 7.

For heat balance computations and efficiency checks, this water flow-water temperature recorder provides sufficient information. However, an automatic calculator or analog computer is required to provide instantaneous indication and record of heat absorbed by the water. The btu meter of the author's company is just such an instrument. It takes an electrical impulse proportional to the rate of water flow, multiplies it by another impulse proportional to temperature difference and produces a signal proportional to Btu per hour. This signal actuates a receiver mechanism in a recorder.

The flexibility of this particular recorder is such that it can include an integrator for obtaining the total heat absorption, an additional receiver element actuated by an air flow measuring transmitter, and a pneumatic transmitter to be actuated by the Btu receiver establishing a signal for control purposes. This is shown in Fig. 7. The air flow recorder is calibrated on the basis of actual combustion tests on the job so that when the Btu record and air flow record are coincident on the chart, optimum fuel-air ratio conditions exist.

During a sudden and fast load change, the Btu meter provides another important function. At that particular instant, it becomes an indication of load *demand* since the measuring elements will sense this load change before any changes are made to the firing rates. The pneumatic signal established by the Btu meter can therefore be used as the load index in the three-element master control system described above.

In the application of a Btu meter to a high temperature hot water boiler system, the flow metering element (orifice or flow nozzle) is rarely placed in the boiler outlet line to the expansion tank. There is the possibility of flashing across an orifice located there, since the difference between actual pressure and saturation pressure at that point is very small.

Consequently, it has been customary to place the orifice in the water line to the boiler. The return water temperature is a variable and the variation in density at this point makes the meter flow measurement, and thus the Btu measurement, in error. In many installations, the variation of temperature above and below that for which the orifice is designed is sufficiently small to make the error less than two or three per cent and no serious complications result.

On some installations the maximum *continued on page 100*

Fig. 1. Mill-water pumps in power plant supply 150,000 gpm to processes

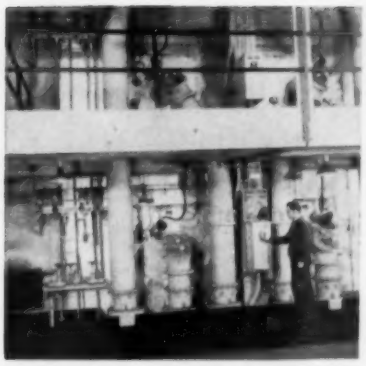
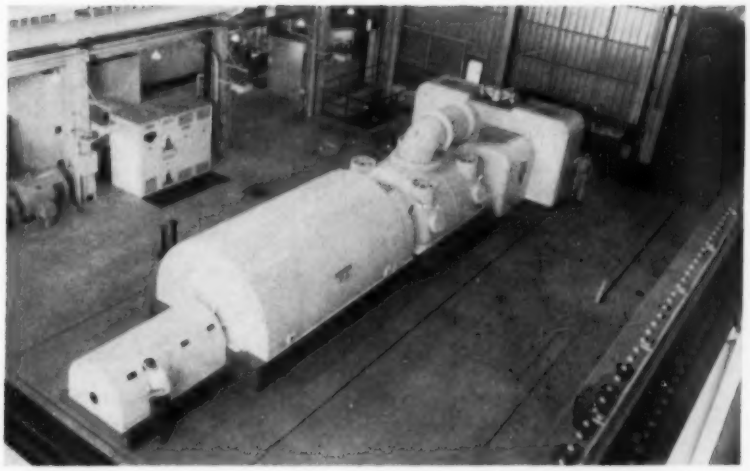


Fig. 2. Single 450,000-lb-per-hr coal-fired boiler; 1325 psig 1000-F steam

Fig. 3. Exterior view of Reserve power plant taken from the coal storage pile

Kilowatts for Taconite



RECENT CALL at the great E. W. Davis taconite works of Reserve Mining Co at Silver Bay, Minnesota yielded these fine pictures. Plant processes 3,750,000 tons of iron ore pellets a year received from great taconite ore body of 1,500,000,000 tons on eastern tip of Mesabi Range. Processing requires 90 kwh and 50 tons of water per ton of concentrated ore. Here is shown the Sargent & Lundy—designed power plant

Fig. 4. Turbine generator rated at 40,000 kw actually delivers 50,000

Table of performance of power plant

Steam Generator 1–450,000 lb per hr.	
Turbine Generator Unit 40,000 kw 1250 psig 1000 F	
Gross generator output, kw	50,000
Auxiliary power, 5.5%, kw	2,750
Net sent out, kw	47,250
Steam rate to turbine, lb per kwh	8.55
Btu per kwh to turbine	8,741.2
Boiler efficiency, %	88.3
Btu per kwh generated	9,899.4
Btu per kwh to auxiliaries	576
Btu per kwh Sent Out	10,475.4
Plant thermal efficiency, %	32.58

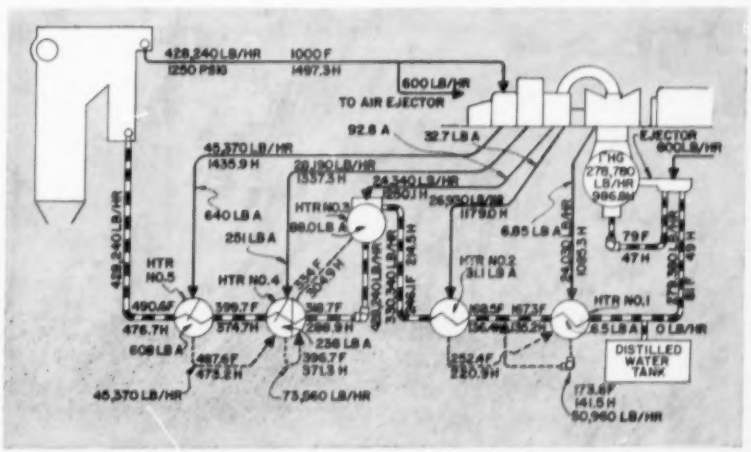


Fig. 5. Heat balance diagram for operation of the Reserve power plant. LBA = psi absolute pressure; H = Btu per lb steam or water. See data table at the left.

Editor's Note:

This is the first of several articles on how to set up and begin operation of an industrial power plant. Since Author Paul Garay has had wide experience in this field, his articles will be valuable to those men for whom a new power plant is a new venture. If you wish to save these articles for reference, write the Editor for tear sheets.

As every power engineer knows, there are plenty of headaches in a brand new plant. But you can avoid many of them if you use these methods to . . . . . .

Train Your Operators Right For Your New Industrial Power Plant

By PAUL N. GARAY

YOUR NEW PLANT will have capabilities for economy, for long life, for ease of maintenance, which are very much in advance of what was expected of the power plant of ten years ago. However, just as mechanisms and designs have been improved, so your consideration of personnel requirements must have been updated. No longer is it sufficient recommendation that an operator has had thirty years' experience. In some cases, this will be found to have been one year's experience thirty times over. Modifying our requirements, of course, depending on whether we are hiring operators, chief engineers, or superintendents, we should expect that our plant staff will have at least the following capabilities:

1. Ability and experience gained from past work.
2. Ability to adapt to newer, more technical operating and maintenance techniques.
3. Adaptability and originality to accept and work with new methods and ideas.
4. Willingness and intelligence to seek, study and assimilate the information contained in monthly periodicals, available from study courses, and gleaned at exhibitions and conferences.
5. The education necessary to handle the work to be expected of them.
6. Sufficient breadth of ability to handle operating, maintenance, paperwork, analysis of performance, planning, improvement (within the limits of the position requirements).

How you will investigate your prospective employees will not be discussed here, since that is more properly an administrative subject; however, do include some thought for estimating the applicants' capabilities in these areas. As a beginning, I would recommend the type of man who holds a marine engineering ticket, since such a qualification endorses a wide range of abilities.

Having made selection of personnel, let us next consider the work schedule. Under today's requirements, provision must be made for a 40-hour week, limited overtime, vacation and sick leave, reasonable assignment of shifts.

To a large extent, the continuity of operation, and the size of our crew will affect the work schedules. Bear in mind that for 24-hour operation, we should have at least five men, more if the plant is large enough to exclude the operator from doing maintenance work, plus the chief engineer.

SHIFT ENGINEER'S SCHEDULE

From Nov. 5 To Nov 19 Pay Period

Shift	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
0000 to 0800	1	1	1	1	1	4	4	1	1	1	1	1	4	4
0800 to 1600	4	2 (5)	2 (5)	2 (5)	2 (5)	2	5	4	2 (5)	2 (5)	2 (5)	2 (5)	2	5
1600 to 2400	3	3	4	4	3	3	3	3	3	4	4	3	3	3

4 Dembek 2822 — 2 Thornton 1311

5 Thompson 2823 — 3 Keith 2821

1 Bell 1177 — (5) Maintenance man, except Sundays

Fig. 1. Typical shift engineers' schedule; numbers move up one every two weeks

Planning Shift Schedule

Each operator is to have a 40-hour week, at least one day off, shifts to be rotated once every two weeks. Assignment of a shift number to each man provides a simple means of rotating the shift every two weeks without undue complications. Every two weeks, each man would move up one shift number, and assume the schedule of that shift (see Fig. 1). This chart, of course, can be manipulated as desired to set up any desired combination. Although an extra man is shown four days a week, you will find that this is a very useful addition, for this shift can be changed as needed to fill up holes in the schedule due to sickness, vacation, etc.

The training you may give your people has been covered in other arti-

cles. I have found the following course to be effective:

1. Study of plant plans.
2. Tracing out of all piping.
3. Identification of all valves and equipment items.
4. Study of equipment manufacturer's literature on use and maintenance of equipment.
5. Explanation by the chief of general operating procedure and requirements.
6. Study of pressures and temperatures existing throughout the systems, and
7. Study of plant directives, operative instructions, information relative to specific areas, such as emergency procedures, equipment failure, use of tools.

Using this outline, you will be able to work out a training program that will be effective and logical. The various phases, of course, should be considered in their relation to one another.

When assigning duties to your staff, try to avoid indefinite responsibility. I have found, for instance, that if the maintenance of a feed pump is assigned to the 8-to-12 man, the pump will be neglected, since each man has different ideas of how to do a job, or when to do it.

All operators, of course, will have parallel duties related to operating, and the daily or shift maintenance in connection therewith. However, unless you maintain a maintenance man or staff, you will find that it will pay to assign definite responsibility for specific equipment to the man best able to do the work.

In the schedule shown, it was our usual plan to arrange maintenance work so that it could be done by the responsible man when he was on the "extra" shift. Emergency work, of course, must be handled as it occurs.

Lubrication, water testing and chemical feeding, blowdowns, checking of operating conditions, inspections, and many necessary routine functions must be handled on a shift-to-shift, or daily basis, and must be done by whoever is on duty at the time. But again, let me emphasize that you should avoid multiple responsibility if you are to get the best efforts from personnel. (*Turn the page*)

Daily Maintenance Schedule
In Addition to Regular Watch Routine

0/0800

Blow tubes. Blow down drums and headers, keeping following in mind: do not blow water walls at rates over 50,000 lb/hr; below this load, valves may be opened fully for a few seconds. When blowing main drum, do so at low steaming rates. Amount of blowdown should be governed by the condition of boiler water sample.

Fill all grease and oil cups and oil reservoirs. Blow out all air tanks, air receivers and filters, including small units on the controls.

Check condensate tank filter petcocks to see if condensate pump suction shows positive pressure. Change and clean filter if vacuum exists in suction line to pumps.

0800/1600

Turn over all machines by hand to keep bearings from binding. Turn tube oil filter handles on I.D. turbines. Change all charts, clean pens.

1600/2400

Check water softeners for proper amount of salt and proper operation.

Monthly Maintenance Schedule
Month of: .....

1. Clean points on water softener by wiping through with brown Kraft paper. Check oil in motor valve gears, grease the entire system. Check packings on poppet valves. Disassemble and thoroughly clean the motor valves. Inspect piping for necessary replacement.
2. Clean each register thoroughly.
3. Inspect reduction gears in turbines for color, scale, wear spots, water in the oil.
4. Clean the lines to control units. Be sure to shut motors off before blowing. Clean Fireye scanner tubes.
5. Clean F. O. and water strainers.
6. Blow down Ranorex lines, inspect belt drive, check reading with Fyrite indicator.
7. Blow down each water tank in plant to remove sludge and deposits.
8. Operate cable going up side of stack, and wipe down with oily cloth. Run pulley around stack track.
9. Check the condensate return pumps at projects. Note operation of float valves. Grease pumps. Motors should be oiled at 3-month intervals only.
10. Inspect and service distribution system. Take up on leaks, operate eductors, and drain valves. (Carry manhole guard, blower, lights, and tools.)
11. Clean all gage glasses as necessary.
12. Go through light-off procedure on idle boiler, testing all alarms and safety features.
13. Check fan dampers and linkages, examine internal bearings for oil leakages.
14. Lubricate the drill press.

Weekly Maintenance Schedule
(Perform at least once each week and note on Log Sheet)

Week of.....

Each Wednesday—Change charts at projects

1. Clean pens, and fill with ink.
2. Clean smoke density indicators.
3. Check the water sumps; clean out oil if required.
4. Pump out oil collection sumps.
5. Inspect the Ranorex and lines. Empty drip bottle, change filters.
6. Test and lubricate overspeed trips on all turbines (start turbines as necessary).
7. Test each fuel oil governor as follows:
   Shut off all burners, cut out one fuel oil governor. Crack fuel oil bypass slightly, and move master boiler control up and down; oil pressure on burner front will move up or down correspondingly if governor is O.K.
8. Test injectors.
9. Operate all relief valves by hand.
10. Test water in idle boiler, if full, and check drying chemicals, if installed.
11. Operate nonreturn valve by opening control line valve.
12. Turn lubricating screw on Fisher diaphragm valves. Relubricate if necessary.
13. Lubricate water softener float valves.
14. Service the chemical feed pumps.
15. Test the Fireye system as follows:
    Remove scanner from an operating burner, and cover; flame should go out in four (4) seconds. Observe to see if electric valve dribbles. Expose scanner to pulsating light, step on foot button, and relay should not operate. Reinsert scanner in socket and light off again.
16. Clean off the Copes regulator tubes.
17. Change compressors.
18. Lubricate soot blowers.

Maintenance to Be Performed at 6-Week Intervals

Period from: ..... To: .....

1. Service each compressor. Check instruction manuals first. Check gauges, and test relief valves by removing and popping on water pressure. Change oil. (Special oil is available for Brunners.) Adjust belts, blow-out cooling fins and intercoolers, clean trigger valve strainers on Worthingtons. Wash each filter in solvent and recoil. Check head bolts for tightener.
2. Lubricate sump pumps, including thrust bearings.
3. Disassemble, clean, change oil in turbine governors. Take up leaks on turbine.
4. Check expansion joint packings on Ric-Wil distribution conduit.

Fig. 2. Examples of how maintenance schedules might be set up for a boiler plant; these can be typewritten or put on stencils for reproduction. Post copies at all watch stations

A schedule of duties should be prepared, detailing what should be done by each operator. This is in addition, of course, to the maintenance schedule which is worked out for equipment items, for each man. A typical duty schedule might be as follows:

12 M. to 8 A.M. Shift:

1. Blow tubes at 4 A.M. daily.
2. Start up and check idle machinery weekly.
3. Check out overspeed trips on small turbines weekly.
4. Tighten up on all leaky packings, gaskets, etc. Make report on major leaks.
5. Blow down steam and water drums. Blow down other tanks as scheduled.
6. Make out shift log and performance report.
7. Clean up.

8 A.M. to 4 P.M.:

1. Check fuel oil tanks, shift suctions as necessary.
2. Receive and check-in fuel and supplies received.
3. Make out daily report, if not done by chief engineer. In any case, make out shift log and performance report.
4. Analyze water, make out dosages for the night man to set up.
5. Blow down gages, glasses, drums.
6. Check batteries in emergency lights, condition of fire extinguishers, adequacy of supplies, such as chemicals, oxygen, fuel, etc.

4 P.M. to 12 M.:

1. Prepare and set up chemical feed treatments.
2. Check out safety features of plant, such as high and low water alarms, feed pump tripouts, automatic controls, flame failure, safety cutouts, etc.
3. Clean burning equipment.
4. Make out shift log and performance report.
5. Test injectors.
6. Shift equipment to equalize usage.

The above, of course, is not a complete guide. You will notice that there is not much time left for the operator to sit in a warm chair and read the newspaper. Much emphasis must be placed on checkout and testing, especially of automatic and safety equipment. It is an important fact that modern items used for control and safety are reliable if consistently used, or tested, but they may malfunction if neglected. You can make a duty list similar to the above by compiling information from manufacturer's instruction guides, from information in plant operating manuals, and from the experience you gain when you forget something.

When setting up your staff, remember too, provision must be made for seven or eight holidays a year, possibly two weeks vacation per man, one to three weeks sick time off, and for extra help for big jobs such as brick repair in a boiler, cleaning of firesides, cleaning of fuel tanks, and similar tasks which should be done seasonally or yearly.

And, last but not least, provision must be made for a personal safety program to be applied and observed at all times and on all work. This program should include both equipment and technique. Gloves, glasses, faceguards, salt tablets, first-aid equipment, respirators, safety-grounded electrical outlets, proper weight-handling equipment, guard rails, and many other items should be considered in an integrated safety program. The National Safety Council and your insurance companies can help you set up your safety program. And once set up, keep your men instructed and up to date. Not only their health and welfare, but your plant is at stake.

Midget Fire, Rescue Vehicles Tailored to Fit at A-C

TWO COMPACT safety service vehicles, each equipped with tools to meet emergency fire or rescue operations and provide Civil Defense preparations, are now in operation at the West Allis Works of the Allis-Chalmers Mfg. Co.

One unit is designed for emergency rescue operations and the other for fire fighting. Both were specifically built for use within the physical layout of the West Allis plant. The two units can reach any location in the main shop area in five minutes and they fit easily into the elevators to reach upper or lower levels. Rescue unit is 42 in. wide, 8 ft long, 5 ft-10 in. high; fire-fighting unit is 42 in. by 10 ft by 5 ft-11 in.

Despite their size, the units carry a wide assortment of equipment. Rescue unit equipment includes two 40-ton power jacks, 2500-watt motor generator for emergency lighting and power, portable resuscitation stretcher, an explosimeter to detect explosive atmospheres, an asbestos suit, asbestos blankets, and a gas mask. There is also a six-ton and a half-ton chain hoist, cable slings, wire and manilla rope, cutting torch, shackles, clamps, blocking, axes, saws, ladders, bolt cutters, a hot-stick and gloves for handling energized electrical wires, and an assortment of smaller hand tools.

Equipment on the fire-fighting unit includes a 170-gal. water tank with booster-pump to provide a 9-min. supply of water for one hose, a 350-lb Ansul dry chemical unit, three 30-lb dry chemical units, a 5-lb CO_2 extinguisher, and a 25-lb liquid foam unit.

Also carried are ladders, hose, axes, wrecking bars, and various nozzles.

Selected personnel on all three shifts of the Plant Protection Department have been training with the equipment twice weekly for the past several months, and this training will be continued indefinitely. Trained drivers are available on call at all times, day or night.

Illustration shows special fire and rescue vehicles made to fit Allis-Chalmers plant conditions. Pint-sized units carry all necessary emergency equipment

Fig. 1. American Coils Co's new plant, Farmingdale, N. J.

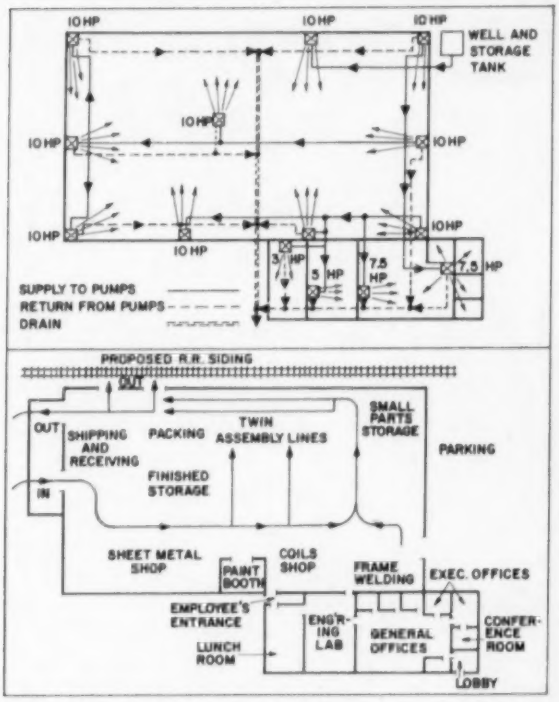


Fig. 2. Top shows placement of 14 "heat pumps," piping, for 63,000 sq ft plant. Lower diagram is of production flow

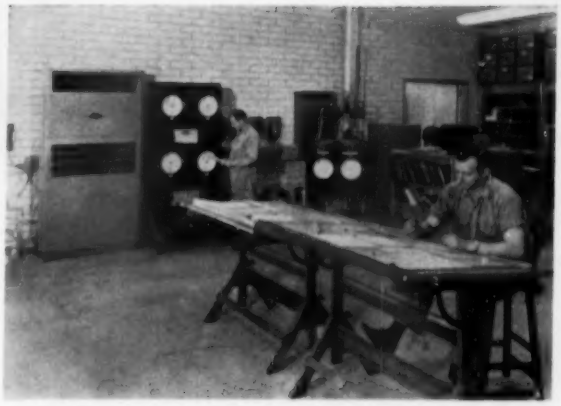


Fig. 3. Lab records necessary measurements for heating-cooling system. 5-hp ACI-H water-to-air "heat pump," left

Fig. 4. One of the 10 units which heat-cool the building's 54,000 sq ft of unpartitioned space used for manufacturing

Heat Pump Made from Packaged Units

CONVENTIONAL PACKAGED air conditioning units have been connected into a complete system, to make an ingenious heat pump installation in the plant of American Coils Co in Farmingdale, N. J.

When outdoor temperatures dropped to 6 F during a week-long cold wave, the "pumps," operating at only 60 per cent of capacity, kept the new 63,000 sq ft building in comfort at an even 70 to 72 deg. Heating costs during the cold wave are reported to have been substantially less than for a conventional steam heat system.

Altogether there are 14 water-to-air "heat pumps" in American Coils' plant. Ten of these are 10-hp units located in the building's 54,000 sq ft of unpartitioned manufacturing, shipping and receiving space. Total capacity for winter operation is 2,000,000 Btu; for summer cooling, the system is rated at 1,470,000 Btu. The combined heat pumps are capable of extracting 1500 gal of water from the air per day, giving more than adequate humidity control. All 14 heat pumps are standard ACI-H units made by American Coils.

In such a system, more pumps can be added at a minimum cost should the plant be enlarged. Another advantage of this kind of packaged water-cooled installation is that it does not require ductwork either for the circulation of warm air during the winter or for the transfer of the condenser heat during the summer.

A number of benefits are realized from this. First is the reduction in installation costs. American Coils estimates that it would have cost $40,000 to $50,000 to install ductwork that would have given equivalent results in air circulation.

The second big advantage is architectural. As no provision for ducts had to be made, it was possible to design the building entirely around its basic function — manufacturing.

Water for this heat pump system is supplied by a 505-ft deep well located just outside the plant building and having a capacity of 350 gal per min, delivered at an approximate pressure of 60 psi. A 10,000-gal storage tank was installed which permits each heat pump to be equipped with automatic water-saving valves which permit automatic operation of each heat pump for peak efficiency.

The storage tank itself is covered with two feet of earth which in turn is covered with black top. This prevents any temperature rise or drop in the water contained in the tank.

While emphasizing that the water-to-air heat pump is not an out-and-out substitute for air-to-air units, American Coils feels that the water-to-air heat pump is considerably superior where ample water is available.

Power Engineering handbook

Principles of Safe Lighting for Pulverized-Fuel Systems

FROM NATIONAL FIRE PROTECTION ASSOCIATION'S CODE 60A COVERING THE INSTALLATION AND OPERATION OF PULVERIZED-COAL SYSTEMS

MANY EXPLOSIONS resulting in loss of life and property damage have occurred in furnaces fired with gas, oil or pulverized coal, due to improper lighting practices. The requirements of a safe lighting-off system vary so widely with fuel and equipment characteristics that detailed rules universally applicable cannot be written. However, the following principles are recommended.

Before injecting any fuel into a furnace:

a. A flow of clean air equal to at least one-fourth that required for maximum output shall be produced through the furnace for at least five minutes to purge the furnace of any fuel and combustible gases that may have accumulated.

b. Each burner shall be lighted with a torch. No burner shall be put in operation by ignition from a distant burner or from hot refractory.

c. Each torch should preferably be located so that its flame will approximately parallel and intimately mix with the fuel stream to obtain contact for an appreciable length of time.

d. Torch shall be so located as to avoid danger of its being snuffed out.

If the ignition has not taken place in five seconds after fuel appears at the burner, fuel to the torch and burner should be shut off and the furnace purged for five minutes. Drafts shall be checked and burners adjusted before reinserting torch and repeating the lighting operation.

After ignition of the main fuel is obtained, the torches should be checked periodically for proper functioning, and should be kept in operation until all danger of losing ignition of the main fuel has passed.

Torch should be cut out after satisfactory ignition is obtained. Torches left burning during regular operation may be a hazard, although there are some conditions such as a low load where their use is justified.

If ignition is lost when a unit is in operation, considerable hazard is present in relighting, and deliberate and well-considered action is generally safer than attempting hurried changes. When ignition is lost: (a) All fuels from all sources including any torches shall be shut off immediately. If the unit is operating on automatic combustion control, reset to manual control. (b) The unit shall be purged before relighting.

If ignition is lost at a relatively high rate of operation and the air flow is not reduced, purging takes place in a very short period of time. For this case (where ignition is lost when operating at above one-fourth maximum rate and

Table opposite shows interlocks and starting sequence for safe lighting of direct-fired pulverized-coal.

fold along this line—outside edges toward you

Note ① INTERLOCKS FOR PRESSURE FURNACE.

(a) Failure of Pulverizer, Primary-Air Fan (or Exhauster) Shall Close Dust-Tight Valves in Burner Lines by Interlock, or

(b) Minimum-Stop Shall Be Provided on Cold Forced-Draft Air Supply to Pulverizer to Insure Positive Air Flow Through All Burner Lines Connected to the Furnace in Event of Such Failure.

Note ② STARTING: Primary Air Flow Should Be Dampered Down As Required to Assure Prompt Ignition and Prevent Blowing Out Ignition Torch.

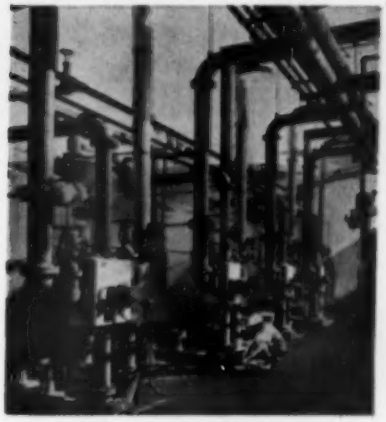
Note ③ STARTING: Applies to Burners That Are to Be Put in Operation If Such Valves Are in Closed Position At Time of Start-up.

DIRECT-FIRED SYSTEMS						
Suction Furnace				Pressure Furnace		
Separate Drives on Pulverizer and Pri. Air Fan (or Exh.)		Integral Drive on Pulverizer and Primary Air Fan (or Exhauster)		Separate Drives on Pulverizer and Pri. Air Fan (or Exh.)		
Fan Started Before Pulv.	Fan Started After Pulv.			Fan Started Before Pulv.	Fan Started After Pulv.	
INTERLOCKS — See Note ①						
FAILURE OF:	STOPS:					
1. Induced Draft Fan	Forced Draft Fan	√	√	√	√	√ (If Used)	√
2. Forced Draft Fan	Pulverizer, Pri. Air Fan (or Exh.)	— √	— √	√ √	√ √	— √	— √
3. Pulverizer	Pri. Air Fan (or Exh.), Raw Fuel Feeder	— √	— √	√ √	√ √ ①	— √ ①	— √ ①
4. Pri. Air Fan (or Exh.)	Pulverizer, Raw Fuel Feeder	— √	— √	√ √	√ √ ①	— √ ①	— √ ①
5. Raw Fuel Feeder	Nothing	√	√	√	√	√	√
STARTING SEQUENCE							
1. Start Induced Draft Fan, and Partially Open Uptake Damper.		√	√	√	√	√ (If Used)	√
2. Start Forced Draft Fan, and Partially Open Secondary Air Damper.		√	√	√	√	√	√
3. Purge Furnace for 5 Minutes. (Air Flow Equal to ¼ Max. Rate.)		√	√	√	√	√	√
4. Adjust Air Flow and Draft.		√	√	√	√	√	√
5. Light Ignition Torches.		√	√	√	√	√	√
6. Start (a)		Pri.-Air Fan ②	Pulv.	Pulv. & Pri.-Air Fan ②	Pulv. & Pri.-Air Fan ③	Pri.-Air Fan ③	Pulv.
7. Start (b)		Open Burner Valves ③	Pri.-Air Fan ②	Open Burner Valves ③	Raw Fuel Feeder	Pulv.	Pri.-Air Fan ②
8. Start (c)		Check Ignition Torch	Raw Fuel Feeder	Check Ignition Torch	Open Burner Valves ③	Raw Fuel Feeder	Raw Fuel Feeder
9. Start (d)		Pulv.	Open Burner Valves ③	Raw Fuel Feeder	Check Ignition Torch	Open Burner Valves ③	Open Burner Valves ③
10. Start (e)		Raw Fuel Feeder	Check Ignition Torch	—	—	Check Ignition Torch	Check Ignition Torch
11. Adjust Pulverizer-Air Control Valve.		√	√	√	√	√	√

cut along this line

First in water conditioning

This Giant Cochrane Sodium Zeolite Plant at Rayonier, Inc., consists of 11 units 10'0" in diameter and 5'0" high. Automatically controlled with Cochrane Hydromatic Valves, these units are capable of treating up to 11,000,000 GPD.



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at RAYONIER'S GIANT JESSUP PLANT

To produce high-quality cellulose requires high-quality water. At Rayonier's Jessup, Ga. plant, more than 20 million gallons of water are softened daily—and all of it softened automatically to zero hardness by 11 Cochrane Zeolite Softeners.

The softeners in this installation are controlled by Cochrane Hydromatic Valves, which in turn are controlled by Cochrane Automatic Timers. Every phase of the cycle—service, backwash, regeneration, rinse and back to service are all automatically controlled.

Zero hardness water is guaranteed. There is no possibility of error in operation or of contaminating the treated water.

Cochrane's leadership in water conditioning, and its complete line of equipment assure you unbiased recommendations for equipment to performance requirements. For complete information on Cochrane Zeolite Softeners, write for Publication 4520-A.

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the corresponding air flow is allowed to remain unchanged) a 5-min purge as a result of this air flow shall be considered sufficient. It is not necessary, and in fact it may not be practical, to maintain the air flow at this high rate, particularly if the ignition was lost when operating near the maximum; hence the air flow may be reduced gradually provided it is reduced to not less than one-fourth the maximum rate.

If ignition is lost at a relatively low rate of operation, the safest procedure requires a proportionately longer time for purging, with no change made in equipment settings that will change the rate of air flow.

For the case where ignition is lost when operating at less than one-fourth maximum rate, the air flow should be left unchanged for a period of not less than two minutes, followed by a *gradual* increase to one-fourth maximum rate through an interval of not less than two minutes, and the purging continued at this rate for a period of not less than three minutes, before attempting to relight the burners.

Upon the conclusion of purging under any of the conditions just described above, the procedure outlined in the earlier sections of this article shall be followed.

Operation of soot blowers may cause loss of ignition if done when the rating is too low. Soot blowers shall not be blown without a fire in the furnace, unless the furnace has been cooled down and is free from smoldering combustible material.

Torches

Oil Torches. Permanent oil torches, if used, shall have a rate of heat input that is sufficient to ignite the main fuel burners in a period not exceeding five seconds after fuel appears at the burners.

Torches shall be installed according to the standards for the installation of oil burning equipment. They are usually provided with spark ignition, or may be manually lighted.

All torches should be designed for No. 1, 2, or 3 domestic fuel oil. Heavier oils should not be used without proper heating facilities.

Portable torches should have a capacity of not less than 3,000,000 Btu per hour. Portable torches are usually ignited from a kerosene swab and should be completely removed from the furnace when not in use.

Gas Torches. Gas having not less than 400 Btu per cu ft and a pressure of not less than 6 in. of water shall be used for an ignition torch.

All permanent or portable gas torches shall have a rate of heat input that is sufficient to ignite the main fuel burners in a period not exceeding 5 sec after fuel appears at the burners, and shall be so designed as to have stable ignition under operating conditions. The gas supply line to the group of permanent torches of a boiler shall have two shut-off valves with a bleed-off to the atmosphere between them, and all three shall be interlocked so as to operate simultaneously. Portable gas torches should be completely removed from the furnace when not in use. Gas torches may be provided with automatic spark ignition, or may be manually lighted.

Pulverized-Fuel Torches. Pulverized fuel from a storage system or from a small pulverizer for a direct-fired or a direct-fired circulating system may be used to ignite larger pulverized-coal burners provided the pulverized fuel for use in such torches is of suitable characteristics to maintain stable ignition. Each torch shall have a capacity of not less than 3,000,000 Btu per hour, and the total capacity of all torches on a boiler should be adequate to bring the boiler up to pressure from the cold condition. These pulverized-coal torch-burners may be ignited with an adequate kerosene swab.

Correction Note: Handy Chart For Determining Fan Horsepower

IF YOU THOUGHT our editorial face was red when we put that correction on John D. Constance's article in the July issue, page 4, you should see our face now! Its color is indescribable. For the second time, we got a decimal point misplaced in the text of Mr. Constance's article Handy Chart for Determining Fan Horsepower, page 106, August issue. The formula as given in the text is incorrect. The formula as given on the chart is the correct one: 0.16 air hp per in. w. g. per 1000 cfm. Somebody or something is putting a hex on us. Please mark your copy to make the formula in the text read 0.16 air hp instead of the present value.

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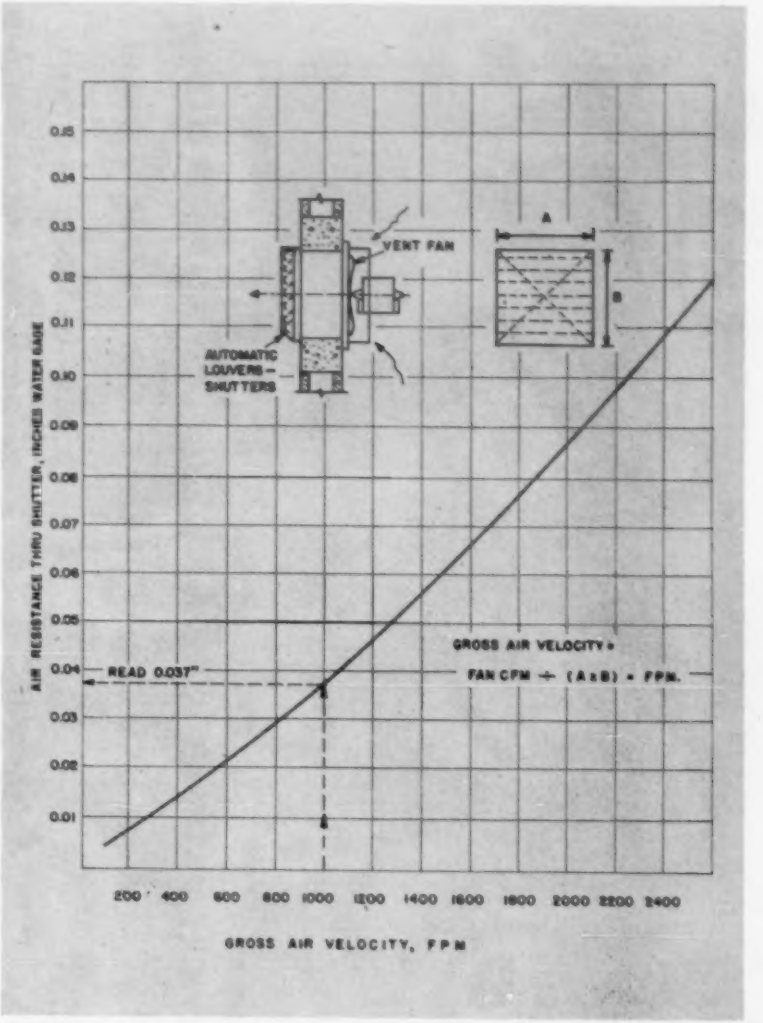
How To Figure Air Resistance Through Fan Louvers or Shutters



THIS USEFUL CHART presents a quick way to solve a common problem. Author of chart is John D. Constance

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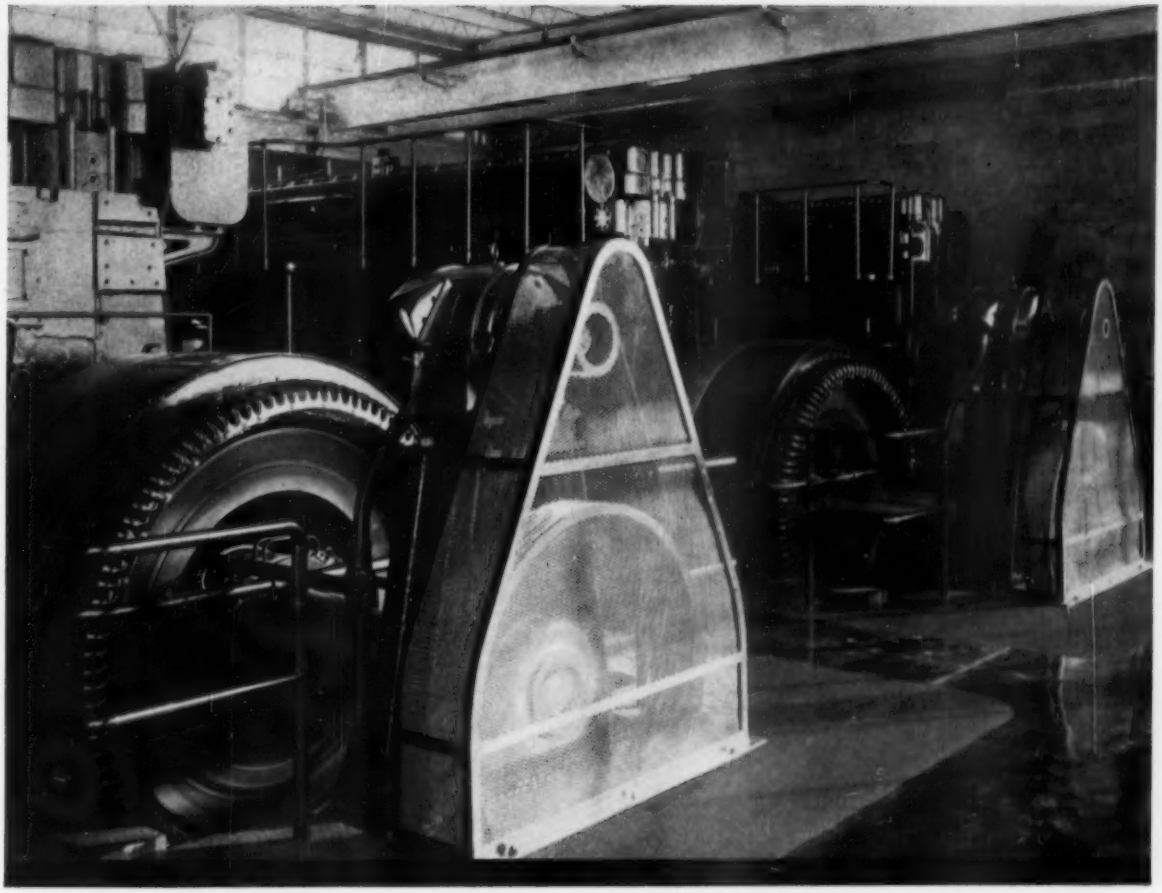

Wins Award

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SINCLAIR DIESEL LUBRICANTS

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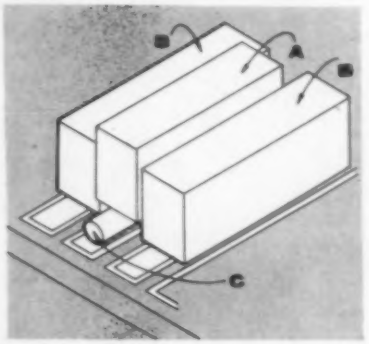
Efficient Square Grinding Set-Up

By F. E. RILEY



Cylindrical rod C is placed under work so that work position is not influenced by bottom face

IN THE ABSENCE of an accurate angle plate for surface grinding the edges of work pieces, this set-up is efficient.

The work piece is first ground flat and parallel on the opposite side faces. For grinding the upper surface, A, square with the two sides, a pair of parallels, B, are placed one on each side of the work to support it vertically. To ensure that the work position is not influenced by a crooked bottom face, a cylindrical rod, C, is placed under the work and on the top surface of the magnetic chuck. The work is supported from below by the rod which also allows it to align itself with the faces of the two parallels.

The hold of the parallels on the work will be enhanced if they are arranged so that the magnetic circuit from the chuck flows equally through the parallels and the work. The squareness of the finished work is, of course, dependent on the squareness of the two parallels. The method is suitable for very narrow work pieces, such as thin plates.

Sticker Helps Tally Load Tap Changes

HERE'S a useful idea from General Electric — a 5 by 5-in. adhesive-backed sticker which can be mounted on any convenient spot on the transformer control panel.

This simple device permits operators to keep an easy log of voltage level, band width, compensator and time delay settings plus number of operations. G-E is supplying these stickers on all LTC power and medium transformers, and extra copies for use on existing G-E transformers are available through the company's Apparatus Sales Offices.

Headings at top of the sticker read: Voltage Level; Band Width, Compensator — Resist., React.; Time Delay-Sec — Raise, Lower; No. of Operations; Date; By.

fold along this line—outside edges toward you

How To Dry Out a Transformer

THERE ARE FOUR METHODS that may be followed in drying out transformers: by internal heat, by external heat, by internal and external heat, by heating and applying a vacuum. These four methods are well described in a recent booklet from Westinghouse.

(1) By Internal Heat

Alternating current is required for the first of these methods — by internal heat. The transformer should be placed in its case with oil and with the manhole cover removed to allow free circulation of air. The low-voltage winding should be short circuited and sufficient voltage impressed across the high-voltage winding to circulate enough current through the coils to maintain the coil temperature at 80 to 90 C as measured by winding resistance.

About one-fifth of normal full-rated current is generally sufficient to do this. The impressed voltage necessary to circulate this current varies within wide limits among different transformers. This voltage will generally be approximately ½ per cent to 1½ per cent of the normal voltage of the winding at normal frequency.

The end terminals of the full winding must be used, not taps, so that current will circulate through the total winding. The amount of current may be controlled by a rheostat or a regulator in series with the high-voltage winding.

This method of drying out is superficial and slow and should be used only with small transformers and then only when local conditions prohibit the use of other methods, Westinghouse says.

For air-cooled transformers, circulate approximately full load current. Do not allow the winding temperature to exceed 100 C by resistance or by spirit-type thermometer placed in the ducts. Do not use mercury thermometer. Otherwise, follow directions for oil transformers.

(2) By External Heat

The transformer may be placed in its own tank without oil and externally heated air blown into the tank at the bottom through the main oil drain valve. A blower or fan should be used to get proper circulation of the air through the transformer. It is essential to force as much heated air as possible up through the ducts in the coil and insulation assembly. Baffles may be necessary between the core and coils and the tank wall to close off as much air leakage space as possible to force the air up through the ducts.

It is essential with this method to have sufficient blower capacity. Estimate the blower capacity as 1 cu ft of free air per 10 kva. The air inlet opening should be at least 20 sq in. per 1000 cu ft of air. Radiator and drain valves may be used to get this area of opening. if adequate openings are not available the method should not be used. The manhole at the top of the transformer will be sufficient for the outlet.

The method of heating the air must be selected in view of local conditions. Electric heat, steam heat or hot air from fuel combustion may be used. The hot products of combustion must be used in connection with a heat exchanger to exclude products of combustion from heated air.

The air heating surfaces of either electric heaters or heat exchangers must be large enough to prevent formation of scale. Hot particles blown into the transformer could result in serious trouble. This is particularly true of electric heaters. Note also that heaters should be so placed as not to subject the transformer coils to direct radiation.

If for any reason it is not expedient to place the transformer in its own tank, it may be placed in a wooden box with air inlets at the bottom and air vents near the top. The same precautions as given for drying in its own tank should be taken to see that the air is forced to circulate through the oil ducts in the insulation.

When drying ASL transformers, it may be advisable to place the core and coil assembly in a non-inflammable box with openings at top and bottom, or in a suitably ventilated oven.

For oil-immersed transformers limit coil temperature by resistance to 90 C and air inlet temperature to 90 C. For ASL transformer, limit coil temperature

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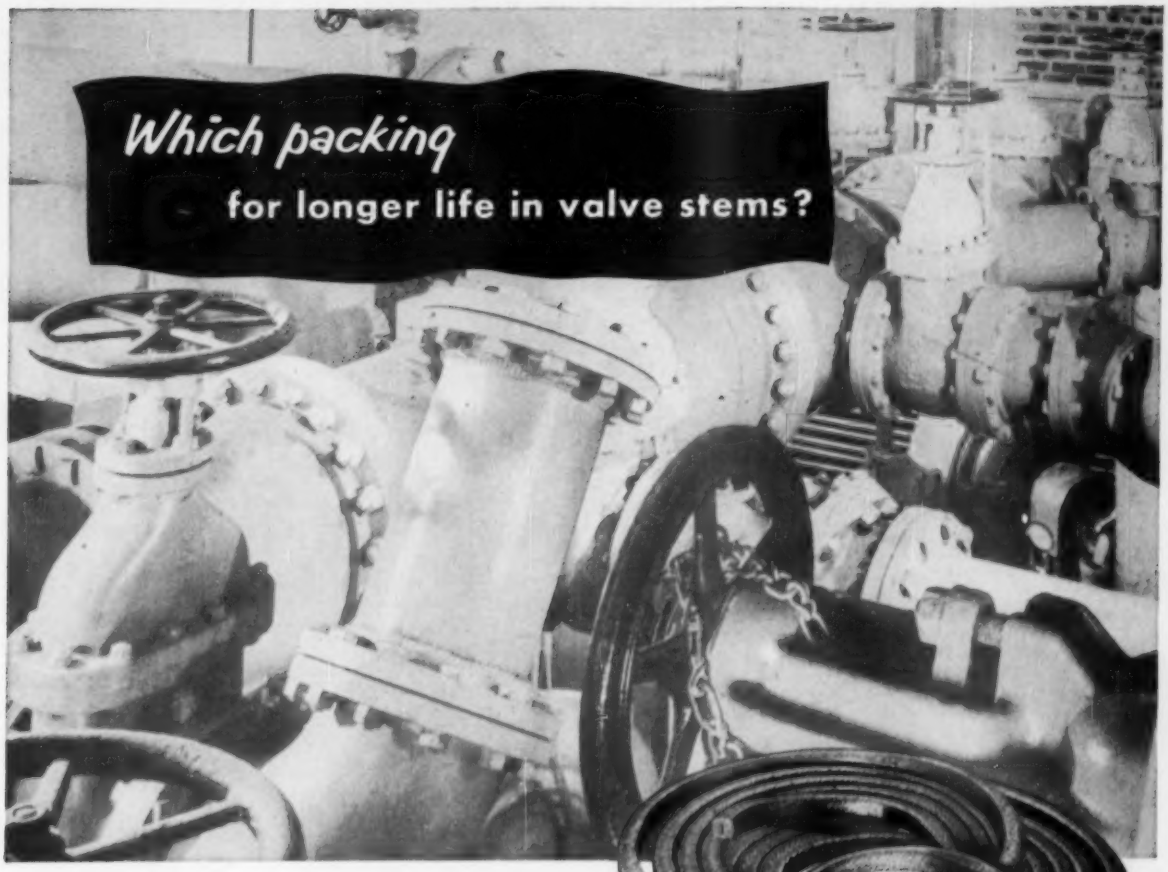

. . . for heavy fluids, steam, water and gas . . . it's J-M Jewett®

Strong, tough Jewett has been proven the ideal packing for heavy duty valve stem service against crude and heavy oils, tar, molasses and other heavy gummy fluids. It also provides efficient sealing against steam; fresh or salt, hot or cold water; air; gas and some chemicals requiring a packing free from rubber.

The basis of Jewett's exceptional durability is its construction of high-quality long fibre asbestos yarn with fine copper wire inserts. This yarn is braided over a lead ribbon core and formed square. Style 10 is treated with a heavy bodied, heat-resisting lubricant which won't bleed in valve stem service. Furnished graphited in coil or ring form in sizes from ⅛″ up.

. . . for superheated steam and gases to 1200F it's J-M High Temperature

When valves are operating in high temperature service, your best packing choice is Johns-Manville High Temperature Style 397. It retains its resilience, holds a tight, lasting seal against superheated steam and dry gases under elevated pressures and temperatures up to 1200F.

To obtain this high sealing efficiency, Johns-Manville braids asbestos yarn of high purity over a plastic core of special heat resistant composition. For extra strength, the yarn is reinforced with tough heat and corrosion resistant Inconel wire. The packing is formed square and then lubricated with graphite. Furnished in ring, coil and spiral form in sizes ¼″ to 1″.

Your local J-M distributor carries full stocks of Jewett, High Temperature and other packings. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

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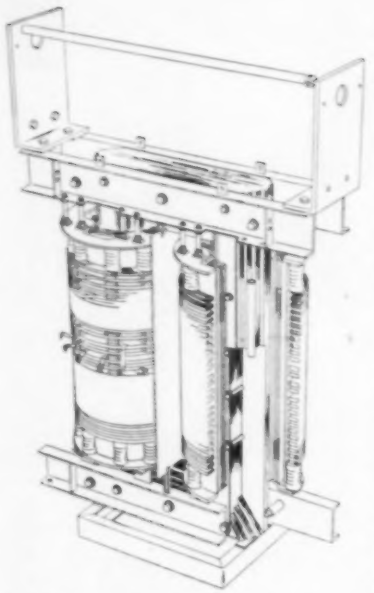

Fig. 1. Cut-away section of air-cooled transformer

to 100 C by resistance and air inlet temperature to 110 C.

It is essential that every precaution be taken to prevent fire when drying out by this method The set-up must be watched very carefully during the entire drying period. If the blower should stop, the heater must be shut off at once to prevent severe overheating.

(3) By Internal and External Heat

For ASL transformers, this method is a combination of the two previously described methods. It is by far the quickest method. The current required will be less than for internal heating above, but should be sufficient to produce the desired winding temperature as given above.

(4) By Heating and Applying Vacuum

This is a combination of heating and vacuum drying that will give rapid, thorough drying. The transformer in its own tank is heated by method 1, 2, or 3 until the winding temperature measured by resistance is 80 C to 90 C. The sources of heat are then regulated to maintain this temperature for at least 24 hours in order to have the transformer uniformly and thoroughly heated. The sources of heat are then shut off and the transformer tank sealed. A vacuum is applied to the transformer tank through the upper filter press or other connection in the top of the tank. The vacuum should reduce the pressure to as low a value as possible. The highest vacuum permitted by the tank design is stated on the instruction plate. The pressure should not be reduced below that allowed by the instruction plate statement.

In the case of full-vacuum tanks the evacuating equipment should be capable of producing a continuous vacuum of at least 28 inches of mercury in the transformer tank. The rate of removal of moisture is increased by the use of a high vacuum with the corresponding depression of the boiling point of water.

The vacuum is maintained by continuous pumping until the temperature of the windings drops about 40 C measured by resistance. At this point the pumping is discontinued, the vacuum is released and the heating resumed to bring the windings again up to 80 to 90 C. The insulation resistance is then measured to check the progress of the drying. The process described above is then repeated until the insulation-resistance-vs-drying-time curve indicates that the windings and insulation are dry.

The number of heating and vacuum drying cycles necessary will depend upon the amount of insulation to be dried and on its moisture content. The minimum number of drying cycles will be at least three, the maximum may be as many as seven or more complete cycles in extreme cases. Drying time will require from one to two or more weeks depending on the number of drying cycles necessary.

Drying may be accelerated by obtaining more uniform heat distribution in the insulation where facilities are available for readily transferring and storing the oil in the transformer.

The procedure is as follows: The transformer, in its own tank and filled to the normal oil level, is heated by circulating full load or 1¼ times full load current through the full windings as described in method 1. Self-cooled units with radiators may be heated by closing the radiator valves on all except 2 or 3 radiators. These valves are left open to allow oil circulation through the transformer thereby obtaining more uniform heating of the insulation by the hot oil. Forced-oil-cooled units should have at least one oil pump running.

The temperature of the windings should not be allowed to exceed 80 to 90 C as measured by winding resistance. If check measurements during the heating period indicate that this temperature range will be over-shot, the current should be reduced.

Top oil temperature serves as a good indication of the heating of the internal parts of a transformer. A constant value of top oil temperature indicates that the heating for a constant input has reached an equilibrium condition. Thus, after the top oil temperature has been constant for four hours and the winding temperature constant in the range of 80 to 90 C the heating may be assumed to have reached an equilibrium condition. The current is then shut off and the oil transferred from the transformer to the storage tank as rapidly as possible. The insulation resistance is measured and the tank sealed. Vacuum is then applied as previously described.

When the temperature of the windings are measured by resistance drops to about 40 C the oil is allowed to flow back into the transformer without releasing the vacuum. The vacuum increases the rate of oil transfer but considerable care is necessary to prevent oil from being drawn over into the vacuum line. Extreme care should be used in this regard if a reciprocating type of vacuum pump is being used as they have very small clearance compared to air compressors. A slight amount of oil in the cylinder may result in a blown gasket or fractured or blown cylinder head.

The vacuum is released after the transformer is filled to the normal oil level and the heating cycle started. If facilities are available for maintaining an oil temperature of about 90 C during the storage period the heating cycle of the transformer will be shortened.

Methods Recommended for Drying

The order in which the use of the above methods is recommended when there is a choice of method is 4-2-1 for liquid-immersed and 3-2-1 for air-cooled transformers. Methods 2 and 1 are much slower and less positive than the other method given.

Method 4 is the one recommended by Westinghouse to be used whenever possible. The other methods are much slower and much less positive in the drying process.

There is no definite time required for drying out a transformer. One to four or more weeks will generally be required for methods 1 and 2 depending on the condition of the transformer, the size, the voltage and the method used. Method 3 for air-cooled and method 4 for liquid-immersed will be more rapid than methods 1 and 2.

Details to be Regarded

If the initial insulation resistance be measured at ordinary temperatures, it may be high even though the insulation is not dry, but as the transformer is heated up it will drop rapidly. An insulation resistance of 100 megohms measured at 25 C is only 9.9 megohms at 75 C. The one megohm rule applies only for temperatures in the range 70 to 80 C and in air, rather than in liquid.

The insulation resistance measured at a constant temperature will generally have a gradually increasing trend as the drying proceeds. Towards the end of the period the increase becomes more rapid. Large changes in the measured insulation resistance may be caused by temperature variations. Insulation resistance measurements should be made at the same temperature in so far as it is possible to do so. Measurements should be taken at about four-hour intervals when drying liquid-immersed transformers by Method 1, 2 or 4 and at the end of each heating cycle after the oil is drained but before applying vacuum when using Method 4.

For air-cooled transformer, measurements should be taken at two hour intervals.

Resistance Curve

A curve of the insulation resistance measurements should be plotted with time as abscissa and resistance as ordinates. The resistance points plotted should be the measured resistance corrected to a temperature of 75 C. The drying curve will generally show wide variations in the resistance values during the first part of the drying period. The variation of plotted resistance values from the mean curve becomes less as the

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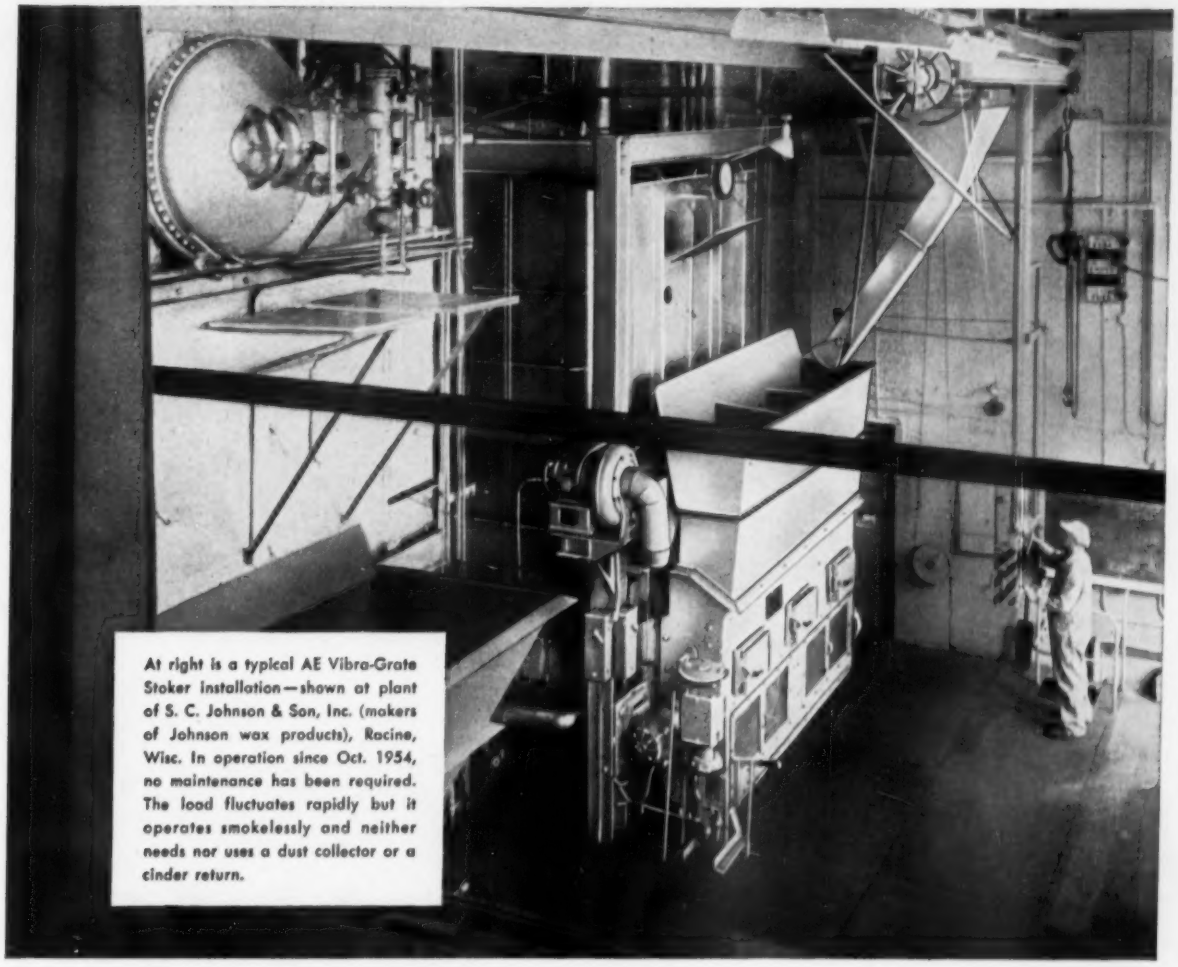

At right is a typical AE Vibra-Grate Stoker installation—shown at plant of S. C. Johnson & Son, Inc. (makers of Johnson wax products), Racine, Wisc. In operation since Oct. 1954, no maintenance has been required. The load fluctuates rapidly but it operates smokelessly and neither needs nor uses a dust collector or a cinder return.

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moisture works out of the insulation. The drying should be continued until consistently high values of resistance are obtained for at least four consecutive measurements covering a period of at least sixteen hours of the drying period.

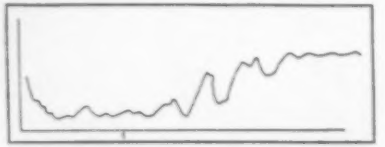


Fig. 2. Typical drying curve shows wide variations

As the drying temperature approaches the point where organic fibrous materials deteriorate, great care must be taken to keep the winding temperature as measured by winding resistance below 90 C. It is considered good practice to try to keep from exceeding 80 C. This allows a 10 C margin for errors in measurement.

Caution

When the transformer is received from the factory it is soaked with oil and in an inflammable condition. It may be ignited very easily by an arc, spark or flame of any kind. Smoking near a transformer during the process of drying out should not be permitted. It is essential that adequate fire fighting equipment be at hand during the drying process. It is recommended that only an inert gas be used for extinguishing a fire if one should occur. Carbon tetrachloride, soda-acid, foamite or water-type fire extinguishers should not be used as they cause considerable additional damage. The extinguishing equipment may be in the form of several large fire extinguishers or cylinders of inert gas; such as, carbon dioxide or nitrogen. The gas may be piped direct to the transformer tank in order to flood the tank rapidly with gas if a fire starts. All personnel concerned with the work of drying should be fully informed as to the procedure to be followed if a fire occurs. Each person should know exactly what to do if a fire starts. Alertness in extinguishing a fire may mean the difference between a total loss and only minor damage and will greatly reduce repair expense.

It is not safe to attempt the drying out of transformers without constant attention by competent personnel.

Warning—Inspect Those Fire Extinguishers!

ON FEBRUARY 12, 1957, in one of the Chicago industries, a fatal accident occurred which is thought to be the first of its kind.

A small fire had broken out. An employee, a very capable workman, was going to use a 30-lb dry-powder type of hand fire extinguisher to put out the fire. He rested the extinguisher on some grating. Facing the top of the extinguisher, the employee bent over to put it in operating condition. While performing this act, the top part of the cylinder separated from the bottom and took off like a rocket, striking the employee in the head.

Because only the bottom of the extinguisher was found at the scene of the accident, and because of the nature of the injury, the immediate assumption was that the rest of the cylinder had exploded in some way and shattered to bits. However, finding of the top part of the extinguisher intact was evidence that there was no explosion. It separated from the bottom of the extinguisher, took off, struck the employee, and continued through the air to some 30 ft away.

An intensive investigation was conducted to determine the cause. It was concluded that the bottom of the extinguisher had been weakened from corrosion, resulting in the separation. There will be exhaustive studies to determine all of the factors contributing to the failure of the extinguisher.

In the meantime, the following precautionary steps are recommended by National Safety Council.

1. Immediate inspection of all fire extinguishers for corrosion.

2. Special emphasis on inspection of extinguishers which come in direct contact with the floor for any extended period of time, and those which come in contact with acids, or are located in acid areas.

3. Hydrostatic test of extinguishers at regular intervals as conditions warrant.

fold along this line—outside edges toward you

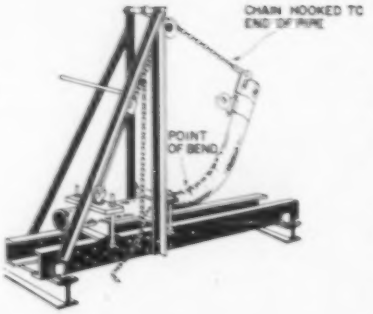


Fig. 1. Jig to be used on the job with oxyacetylene equipment. Bend template first for accuracy

Wrinkle Bending of Malleable Pipe

By J. K. PAUL

MAKING TURNS with screwed or welded fittings results in considerable restrictions to flow, whether the material is a liquid or a gas. There is also the tendency to develop a weak spot when the pipe is subjected to expansional stresses due to thermal effects or those induced by surges or water hammer. While welded joints are less vulnerable to leaks than are the threaded types, joints are still the weakest section.

To overcome these handicaps the pipe is heated and bent to conform to the curvature of the layout by a process known as wrinkle bending. The term indicates the excess metal's ability to compensate for the reduced radius on the inside, by forming wrinkles.

Both long or short radius bends are developed as desired and the full internal diameter is maintained throughout. Any degree of bend is attained by varying the number of wrinkles and the degree of bend for each one. There is no restriction as to size since pipe from 1 in. to 22 in. is easily heated and bent by the use of power equipment. There is no diminishing of wall thickness.

The jig illustrated in Fig. 1 can be moved onto the job along with the oxyacetylene equipment. A band at right angles to the pipe axis and extending about one-half the way around is heated red hot by one or more oxyacetylene blowpipes, depending on the size of the pipes, and the pipe is then bent to provide a change of direction of from eight to 12 degrees. Accuracy can be assured by bending a template first and trying this out in the layout prior to making the bend in the large pipe. With template at hand the pipe is heated at the points marked until there is a red hot band at least two-thirds the distance around the pipe and about two or three inches wide at the middle. The pipe section is then turned 180 deg so that the red hot band is on the underside. At this time the skid supporting the pipe over the ditch line is moved inward so that the weight of the pipe serves to perform the bending function. Larger degrees of turn are easily made by using more than one wrinkle.

For the larger pipe diameters, the bends can usually be performed more easily by using a tractor with a stiff leg or a tripod equipped with a block and tackle (Fig. 2). The stiff leg is placed with the pipe near the heated band.

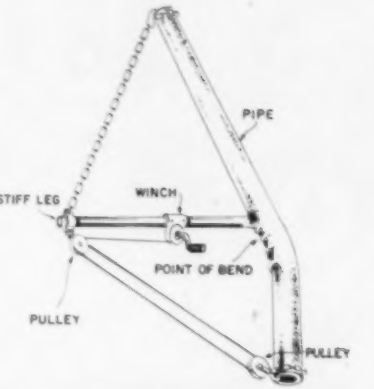
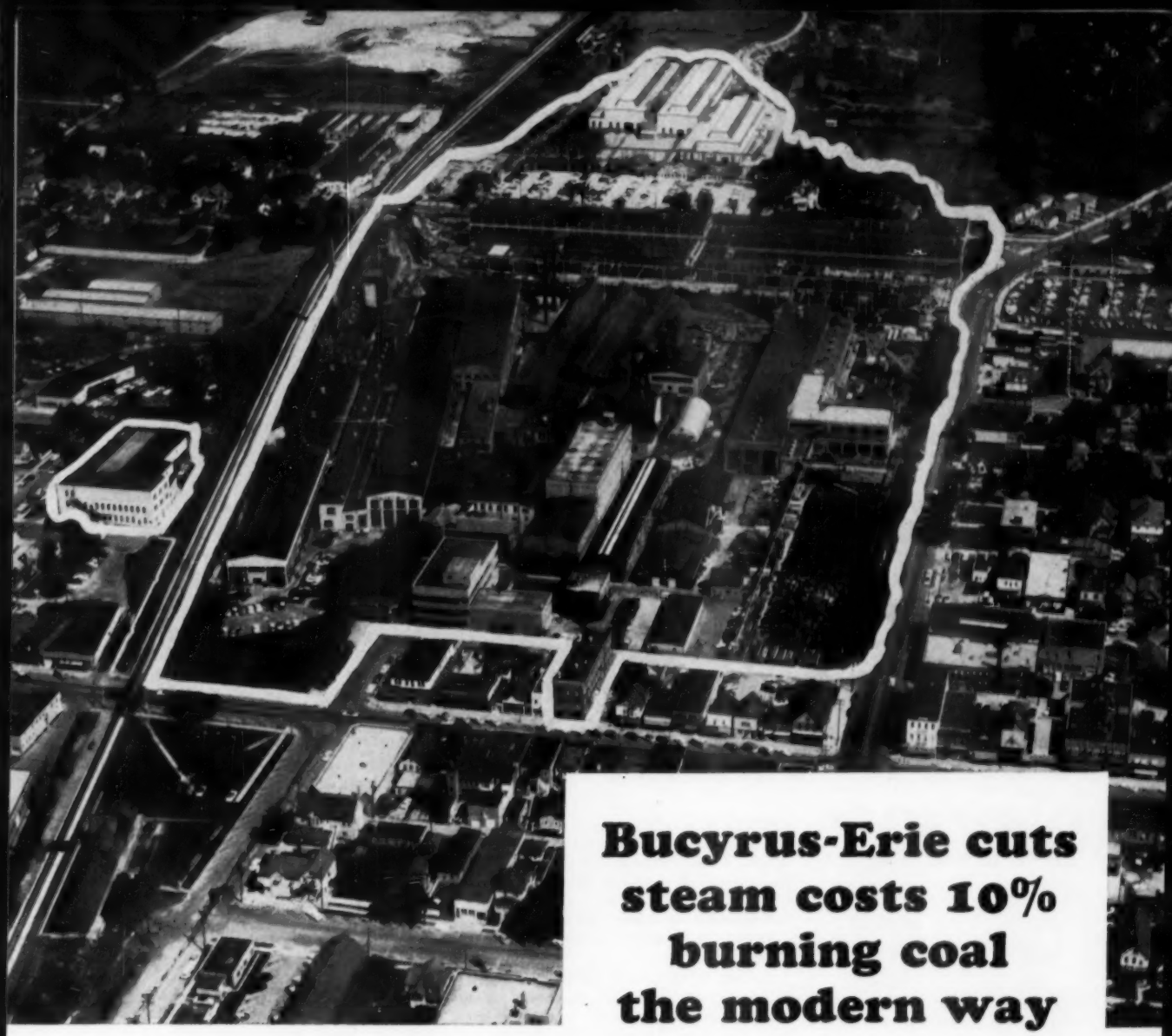


Fig. 2. For larger pipe diameters, bend with tractor, or tripod equipped with block and tackle

cut along this line



Bucyrus-Erie cuts steam costs 10% burning coal the modern way

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Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available. • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use. • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Bucyrus-Erie Company, South Milwaukee, Wis., had a steam generation problem. Not only was original equipment deteriorating but capacity proved inadequate for expanding plant facilities. Working with consultants Gates, Weiss and Kramer, of Milwaukee; the company decided to modernize its power system.

Today the power plant at Bucyrus-Erie is almost completely automatic and utilizes the newest coal-burning and handling equipment. In addition to increasing steam generating capacity 85%, this modernization program has lowered annual steam production costs 10% and labor costs 35%. Burning coal the modern way has increased steam quality, improving production processes and heating throughout the plant.

For additional case histories on burning coal the modern way or for technical advisory service, write to the address below.

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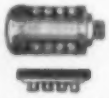

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Stuffing Boxes

continued from page 76

type of stuffing boxes for speeds in the range of 5000 to 9000 rpm or above. Packed boxes in this speed range are not practical. The high surface speeds of the shaft sleeves under the packing generate heat, with the existing types of packing, and this heat cannot be carried away fast enough by the lubricating liquid. Consequently, the packing has a very short life and is extremely difficult to adjust and maintain.

Mechanical Seal

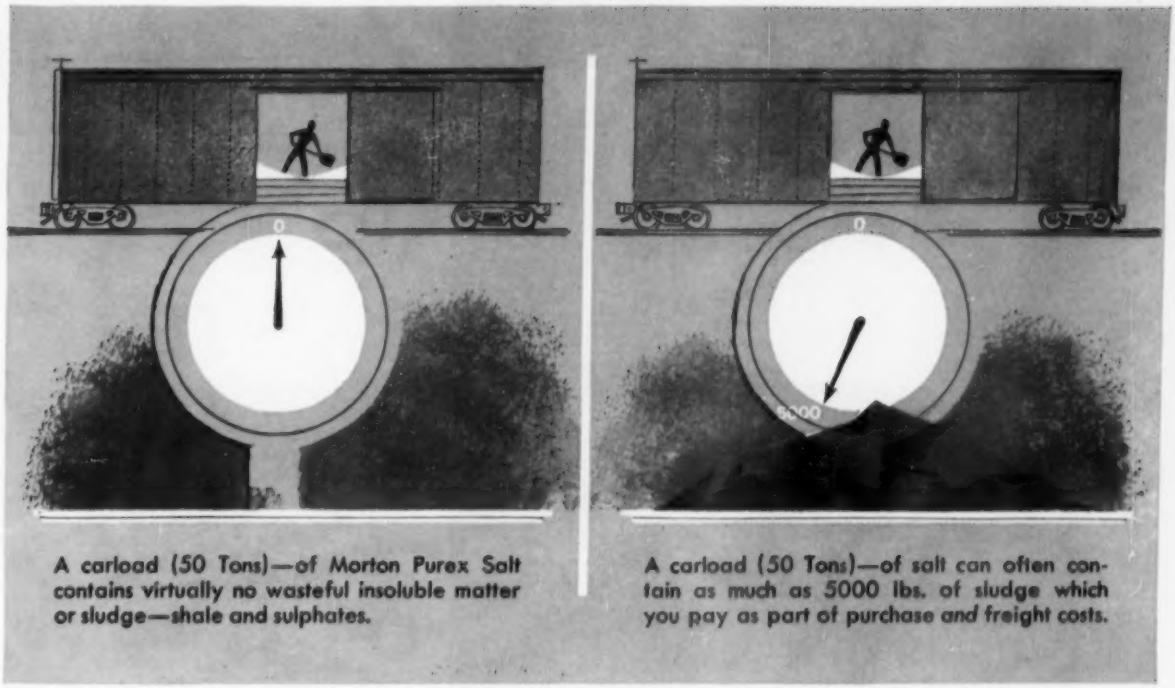
In the last two to three years mechanical seals have been used in barrel-type boiler feed pumps. Their performance has been good and is clearing away some of the scepticism that was prevalent when they were first tried. Theoretically the mechanical seal is the ideal way to prevent stuffing box leakage. Sealing condensate, cooling water, packing, breakdown bushings, bleed-in and leak-off piping can all be eliminated through use of the mechanical seal.

Where mechanical seal know-how is applied to the individual pump installation problem, the following advantages are offered: 1. reduction of costly down-time for replacement with possible longer service life over other sealing methods; 2. boiler feed water leakage is held to lowest quantity of any type of system; 3. operator supervision or maintenance is not required when pump is running or idle.

Figure 12 shows schematic mechanical sealing arrangement. Here a packaged seal with a pump circulating ring are hooked up with a heat exchanger. The pump ring forces the water to flow out through the pipe at the top of the stuffing box. It passes through the heat exchanger where it is cooled to the proper temperature and returns to the seal faces through a pipe tap opening in the end plate. As the water travels back to the pump ring it picks up heat from the surrounding stuffing box and pump shaft.

As this is in effect a closed system, the heat exchanger used only removes the heat picked up by a relatively small quantity of water that has been recirculated. The same cooling water provided for the bearing oil cooler will serve for the heat exchanger. The materials of the various parts are typical of those installed in successful field installations.

With boiler feed pump water temperatures up to 350 F or more it is necessary to reduce the temperature in the seal chamber well below the flash point, in order to have long trouble-free service. The maximum range of temperatures of water from the heat exchanger to the seal faces is about 160 F to 180 F; if possible a range of 120 F to 140 F would be desired. One of the outstanding fea-



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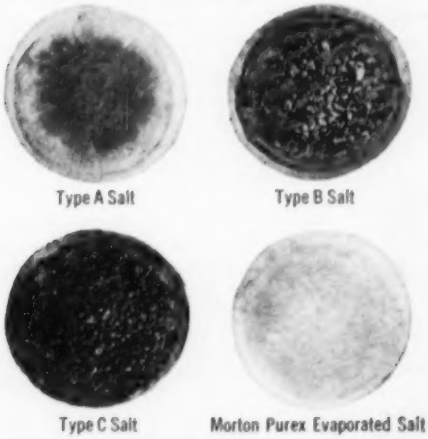
These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



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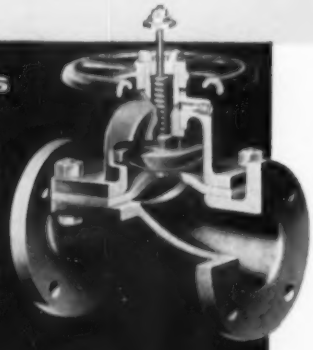

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Stuffing Boxes

continued from page 96

tures of a mechanical seal permits sealing of suction pressures well over 600 to 700 psi without the necessity of pressure take-offs or bleed-in piping. For pressures under 150 psi a standard construction would be recommended; above this limit a balanced type of seal is required.

One of the early difficulties with mechanical seal installations was the taking care of shaft expansion with the high temperatures encountered, the expansion in some cases being more than $\frac{1}{16}$-in. The present designs are more than adequate to provide for the largest possible shaft expansion.

As the sealing faces are susceptible to damage caused by scale or grit, it is best to install filters in the lines from the heat exchangers. The filters need only be used on initial start-up; when the piping system is free of scale the filters can be removed.

The type of seal shown (Fig. 12) is a packaged unit which can be installed in a stuffing box without dismantling the pump. If seal faces need to be replaced this design of seal permits quick access. A spacer type of coupling between the pump and driver will allow replacement of seal or seal faces without moving the driver or opening of the pump. On some limited cases where the feed water temperature is rather low, say 200 to 250 F, and the pump is equipped with water cooling jackets, the heat exchangers can be eliminated. For higher temperatures the cooling jacket is not as effective as a heat exchanger and has the possibility of corroding and not keeping the seal chamber below the flash point.

Summary

A brief review of the merits or disadvantages of the five types:

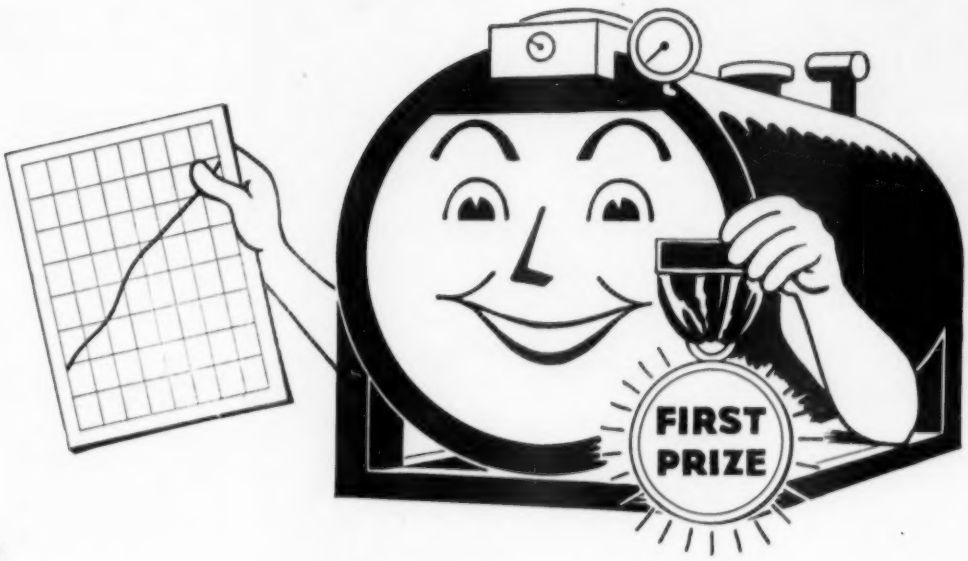
Standard. Simplest design for 150 psi and 350 F maximum. Requires water-cooled jacket, quenching gland and careful maintenance.

Pressure Take-Off. Requires bleed-off piping to suction system and additional heater drain pump capacity. For pressures up to 500 psi and 400 F. Other requirements same as standard.

Condensate Seal. Eliminates cooling water for jacket and gland. Reduces requirements of heater drip pumps. Requires bleed-in and bleed-off piping.

Packingless Seal. Completely eliminates operator maintenance. Requires auxiliary piping and accessories. Reduces requirements of heater drip pumps.

Mechanical Seal. Lowest leakage of any system. Eliminates sealing condensate or cooling water and their piping. No operator maintenance required. Must use heat exchanger. Necessary to establish experience and confidence.



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With a Continental, guesswork is out. You specify the right size for the job, not an oversized boiler just to play it safe. And each boiler-burner unit is rated on its own test-floor performance, not its square feet of heating surface.

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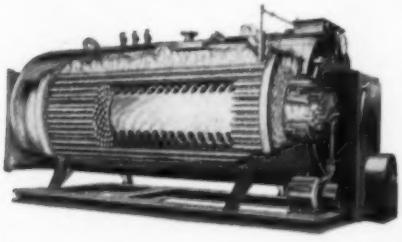

(Left) Series F Continental Automatic Boiler, with modulating control. Other models from 20 to 500 hp, with on-off, low-high-low or modulating controls, burn oil and/or gas. For steam heating or process work at pressures from 15 to 250 pounds, or for hot water heating at low or high temperatures.

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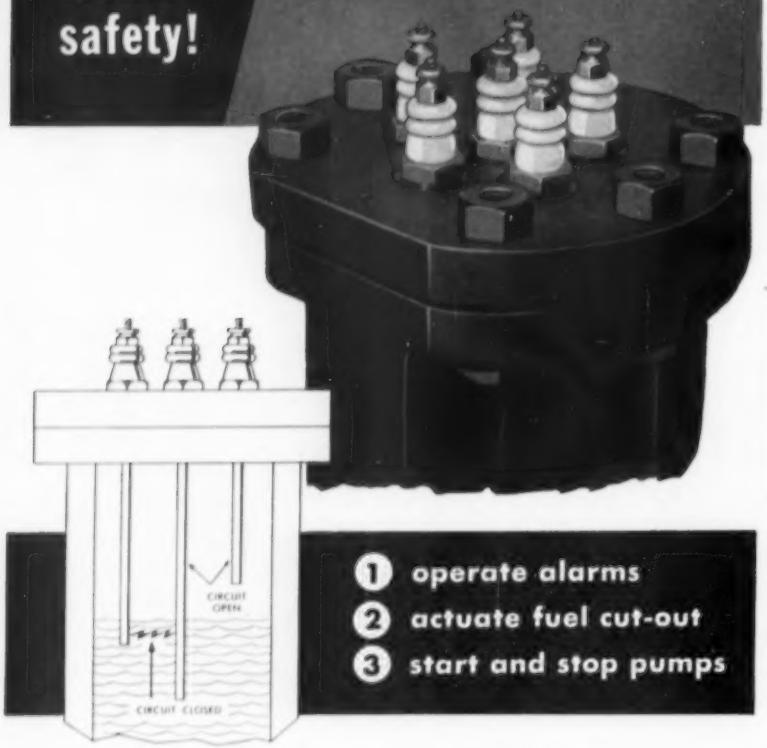
Reliance electrode-type Levalarms®



1 operate alarms
2 actuate fuel cut-out
3 start and stop pumps

For extra safety, guard your boiler water levels with audible and visible alarms that reach operators anywhere in the plant. Or cut fuel automatically, without depending on human action. Here's more protection for boilers working on any pressure to 2500 lbs.

Levalarms operate on isolated electric currents passing through the boiler water itself. When water level gets too high or too low, circuits are made or broken and actuate relays *instantly* to cause ACTION (1, 2, or 3 above).

Four models of Levalarms installed on or in your water columns, provide a selection for various control combinations. Levalarms have no bellows or stuffing boxes; no vacuum tubes or magnets. Action is positive, immediate. Levalarms are unaffected by pressure, temperature or water conditions.

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BOILER SAFETY DEVICES

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H-T H-W Controls

continued from page 80

temperature variations might be such that an error on the order of five per cent or greater would exist. Automatic temperature compensation of the water flow measurement, which can be incorporated in the Btu meter-calculator, may then be desirable.

Another factor must be considered in evaluating the application of the Btu meter to hot water boilers. If steaming should occur in the boiler, the heat absorbed by the water is no longer a function of flow rate times temperature difference and the Btu meter will be incorrect. There is no simple method of compensating for this error. Maintaining the proper pressure-temperature relation at the boiler outlet by the use of a three-element master control system will minimize this occurrence.

Mention of instrumentation should not omit gas analysis instruments such as oxygen and/or combustibles recorders. They are obviously useful in guiding the control of fuel-air ratio for the same reasons that they are useful on steam boiler applications. This independent analysis of oxygen and combustibles content of the flue gas may be particularly useful on steam-pressurized systems where steaming could affect the accuracy of the boiler Btu meter and its value as a combustion guide in conjunction with air flow measurement.

To complete the instrumentation in the boiler house requires the use of water flow, supply temperature and return temperature measurements on each of the distribution lines. These measurements can be recorded for accounting purposes as well as for use as operating guides. As in the case of the boiler instrumentation, these measurements can be combined in a calculator to provide a record of Btu absorbed in the distribution system.

The level of water in the expansion drum is normally used as an indication of need for system make-up water and blow down. A level indicator or recorder system can be used, with suitable alarm contacts, to start and stop the make-up pumps and open or close the overflow solenoid valves which are normally a part of the system. The capacity of the expansion tank and the need for make-up or overflow are such that simple on-off control of these points is sufficient.

Alarms and Interlocks

While the system bypass control valve is automatically regulated to maintain boiler water flows above a predetermined minimum it is highly desirable to have an alarm sounded should the water flow reach a predetermined lower point. Should the water flow reach a certain minimum, the boiler should be shut down automatically. As a further safeguard, a differential pressure switch actuated

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No "even keeled" fisherman would try to save a few cents by fitting his expensive rod and reel with a low quality line.

That's as foolhardy as "saving" on a refractory bonding mortar. Soundest economy is to buy the best.

On most installations, the difference in cost for using the best—SUPER #3000 REFRACTORY BONDING MORTAR—is actually NEGLIGIBLE. With Super #3000 you're guaranteed dependable trouble-free service worth hundreds or possibly thousands of dollars.

Super #3000 is the only refractory mortar which equals or even surpasses the strength, resistance to heat, erosion and abrasion of the best grades of refractory brick. Countless service reports prove it.

Write on your letterhead for a free trial drum of Super #3000, without obligation.

REFRACTORY & INSULATION CORP.

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

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For more data circle 549 on Post Card

H-T H-W Controls

continued from page 100

by the water pressure drop across the boiler is frequently used to shut down the boiler firing equipment if this drop should fall below the minimum.

For oil and/or gas fired boilers, the usual flame-failure precautions should be taken and necessary equipment included. Some localities require the use of smoke density measuring instruments providing not only a record but also a means of actuating an alarm.

A high temperature hot water boiler instrumentation and control system differs from a conventional steam boiler system in three ways:

1. The control of firing rate should be primarily from the outlet temperature measurement on each individual boiler.
2. A Btu meter is used to gage performance and act as an operating guide.
3. Although there is no feed water flow control as such, there is the necessity for maintaining a minimum water flow through each boiler.

A high temperature hot water generating system is inherently a stable one and should be so considered in laying out the application of instruments and control.

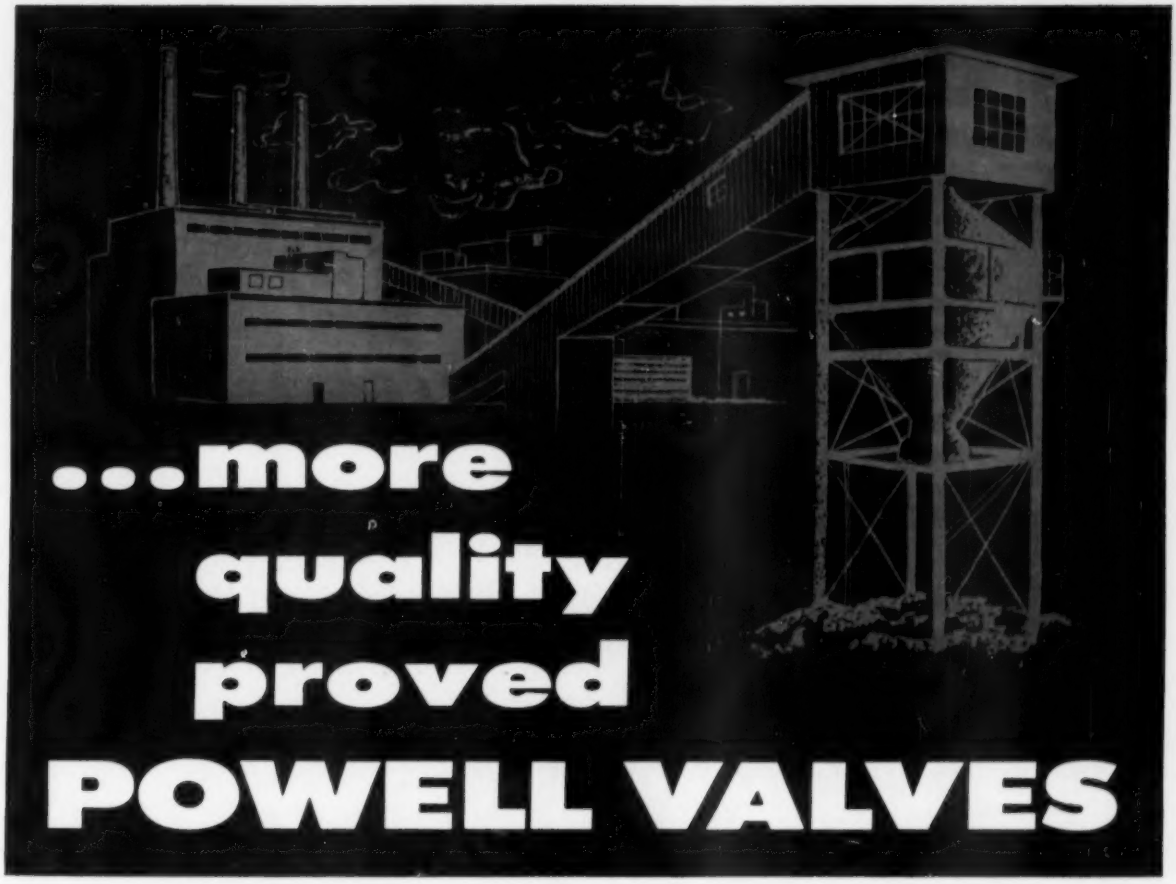
NEW ENGINEERING BOOKS

Technology and Engineering, edited by R. Hurst and S. McLain. First Edition, 420 pages, 6½ by 9¼ in., cloth. Published by McGraw-Hill Book Co, Inc, 330 W. 42nd St, New York, N. Y., 1956. Price $12.00.

This is the fourth volume in a series of 8 on Progress in Nuclear Energy being published by the McGraw-Hill Book Co. This book gives the research worker, industrial executive or student an authoritative picture of the present state of the field of nuclear science. It presents data on the technology of coolants and moderators, on heat transfer, and on the chemical problems arising from intense radiation fields within the nuclear reactor.

Comprehensive surveys also deal with heavy water production processes and the production and properties of nuclear-grade graphite. Since beryllia is of considerable interest at the present time as a moderator there are some short papers on that subject. A section on liquid metals gives detailed discussion of handling precautions for the alkali metals, and covers heat transfer from both the theoretical and experimental points of view.

The engineering section reviews heat trans-



...more quality proved POWELL VALVES

FIG. 9003 W.E.—900-Pound Steel Gate Valve, Bolted Flanged Yoke, Outside Screw, Rising Stem.

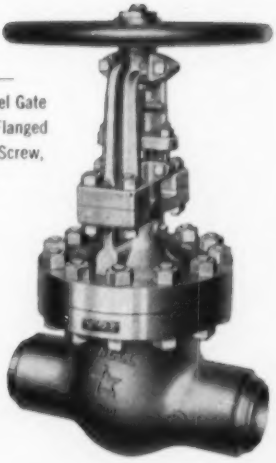


FIG. 375—Bronze Gate Valve for 200 Pounds W.S.P. Inside Screw Rising Stem.

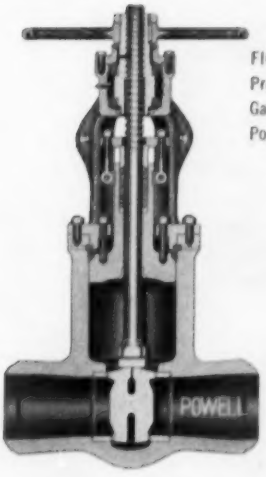


FIG. 11303 (Sec.)—Pressure Seal Steel Gate Valve, 1500 Pounds. Welded Ends.

Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. For every flow problem . . . there is a Powell Valve to solve it.

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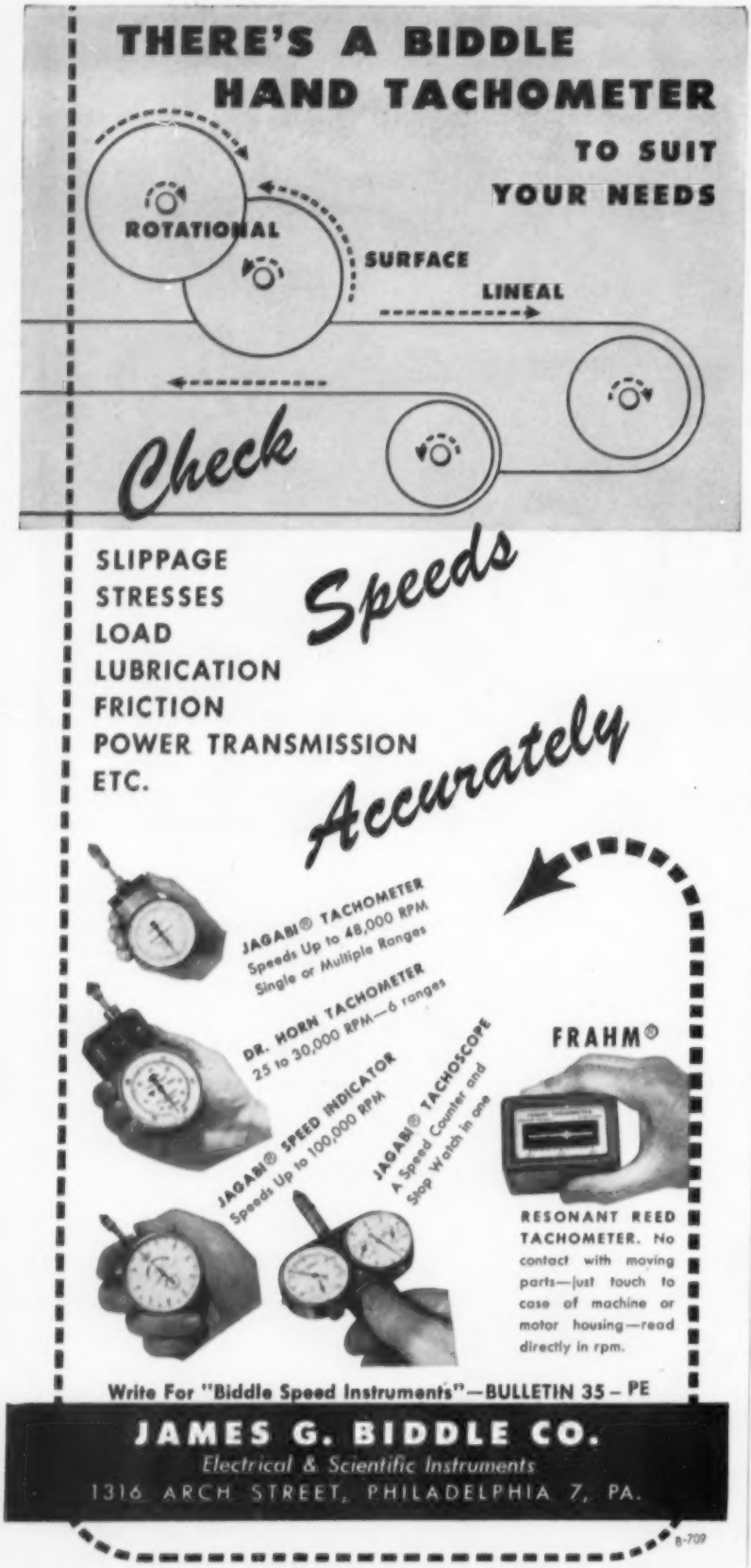


For more data circle 551 on Post Card

Engineering Books

continued from page 102

fer in boiling water systems and experience with the gas-cooled reactors at Saclay, as well as the latest developments in special pumps for liquid metals, for high pressure high temperature water, and for gases as reactor coolants. This section offers short discussions of the heat transfer and thermal stress problems arising from the canning of a heterogeneous reactor fuel rod.

The last section deals with reactor chemistry especially of pressurized water systems and of aqueous homogeneous systems and is particularly concerned with the effects of radiation on the chemical stability of solutions and with corrosion problems of fuel cans and reactor structural materials.

* * *

Nuclear Energy in Industry, by J. G. Crowther. First Edition. 168 pages, 6 by 9 in., cloth. Published by Pitman Publishing Corp, 2 W 45th St, New York, N. Y. 1956. Price $3.95.

This little book is the outcome of the author's attendance at the International conference on the Peaceful Uses of Atomic Energy at Geneva during the summer of 1955. The aim is to give those new to the art some impression of what is afoot — of the innumerable directions in which industry is affected and will be remodelled in a new industrial revolution.

This book is written, not for the nuclear scientist, but for those who will benefit from his work. It tells the story of development culminating in the building of nuclear power plants in various countries of the world, and describes the role of the radioisotope in industry and its effect on techniques and processes. It makes excellent reading for the layman with a scientific turn of mind, and also, of course, for the average engineer in industry who has not had much contact with the new nuclear field.

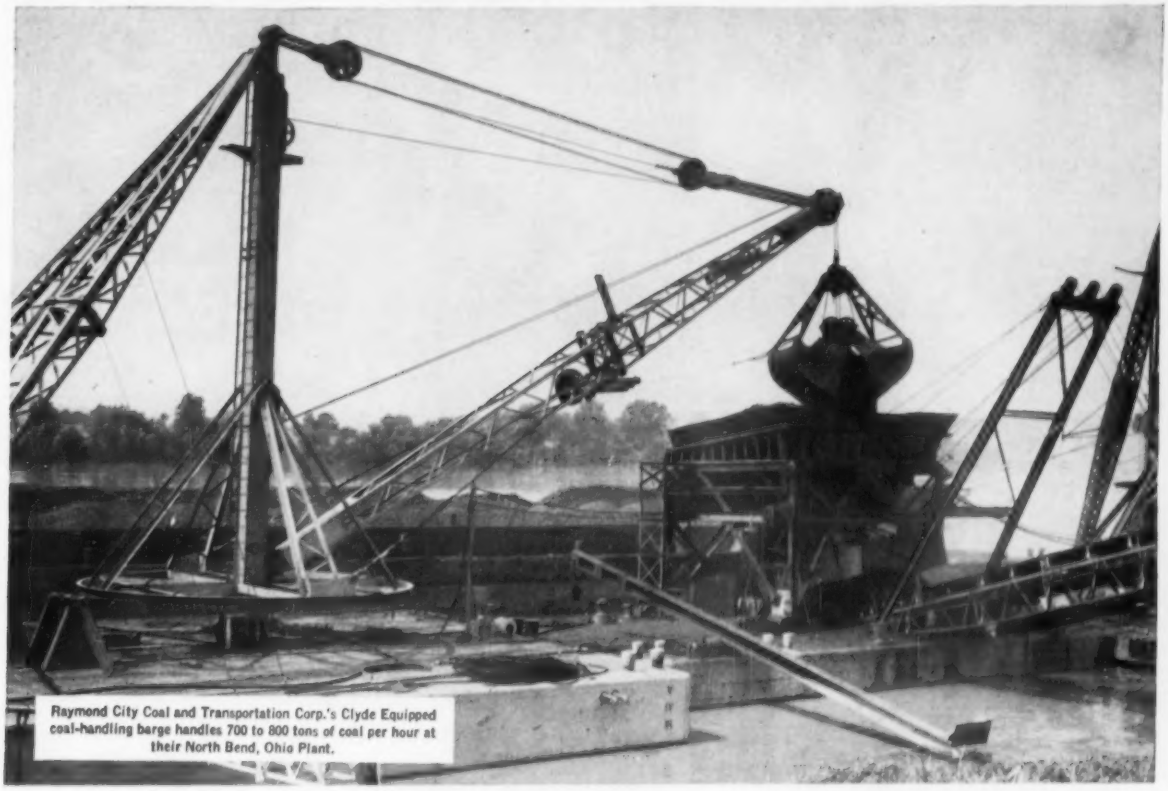
* * *

Symposium on Atmospheric Corrosion of Non-Ferrous Metals, ASTM Special Technical Publication No. 175. 165 pages, heavy paper cover, size 6 by 9 in. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $2.75.

This symposium covers one of the most comprehensive test programs for the measurement of atmospheric corrosion properties of non-ferrous metals and alloys ever attempted. The exposure tests were started twenty-seven years ago by Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys.

The materials utilized included 24 wrought alloys of zinc, nickel, copper, lead, tin, and aluminum. These were exposed at nine significant localities across the country and eval-

How Clyde Equipment boosts production



Raymond City Coal and Transportation Corp.'s Clyde Equipped coal-handling barge handles 700 to 800 tons of coal per hour at their North Bend, Ohio Plant.

FREE DIGGING UP TO 800 TONS OF COAL PER HOUR

A Clyde Barge Derrick loads the coal into a barge mounted hopper. Conveyors then carry it to stock piles, railroad cars or storage bins. Ease of operation, fast cycling, and the long-life dependability of Clyde material handling equipment make this Raymond City set-up "free from trouble since its installation."

Clyde Team Cuts Handling Costs

The Clyde Derrick is only part of this lower-cost material handling story. A powerful, efficient Clyde Hoist and Swinger actuates the bucket and derrick swiftly, easily and safely.

Other Clyde team mates: Two Clyde Barge Movers accurately position the coal barges as unloading progresses. Two Clyde Capstans handle the derrick barge mooring lines.

There's more profit and production in this engineered team by Clyde! Why not capitalize on Clyde's fifty-eight years of engineering and manufacturing achievements. Let the records of proven performance help reduce your material handling costs. There's no obligation.

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25 years of

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At Weyerhaeuser Timber Company, switchgear control batteries in Everett, Wash., sulphite mill are C & D PlastiCal® —the batteries built for control . . . and to last 25 years.

. . . they're C&D PLASTICAL®

Not just "batteries"! These are *engineered* C & D PlastiCal® (lead-calcium) control batteries—batteries specifically designed for switchgear, control, and auxiliary power service —batteries built to deliver high, steady output with only minimum maintenance *for the next quarter-century!*

Weyerhaeuser Timber Co., big suppliers of woodpulp to the paper and allied industries, wanted more than just batteries. Their choice: C & D PlastiCal® —the control batteries with the "more battery for the money advantages."

See why

For details, send for Bulletin CP-536. Find out about the battery of tomorrow—today!

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Engineering Books

continued from page 104

uated after periods of 1, 3, 6, 10 and 20 years, embracing about 9000 test specimens.

The test report lists all data gleaned from these specimens and nine papers discuss in detail the significance of these results in each metals field. Introduction was by W. H. Finkeldey and papers included are:

Resistance of Aluminum-Base Alloys to 20-Year Atmospheric Exposure.
Effect of 20-Year Marine Atmosphere Exposure on Some Aluminum Alloys.
Effect of Natural Atmospheres on Copper Alloys: 20-Year Test.
The Atmospheric Corrosion of Copper — Results of 20-Year Tests.
Atmospheric Galvanic Corrosion of Magnesium Coupled to Other Metals.
Galvanic Couple Corrosion Studies by Means of the Threaded Bolt and Wire Test.
The Atmospheric Corrosion of Rolled Zinc.
The Use of Lead and Tin Outdoors.
Atmospheric Corrosion Behavior of Some Nickel Alloys.

* * *

Symposium on Metallic Materials for Service at Temperatures above 1600 F, ASTM Special Technical Publication No. 174. 200 pages, heavy paper cover, size 6 by 9 in. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $3.50.

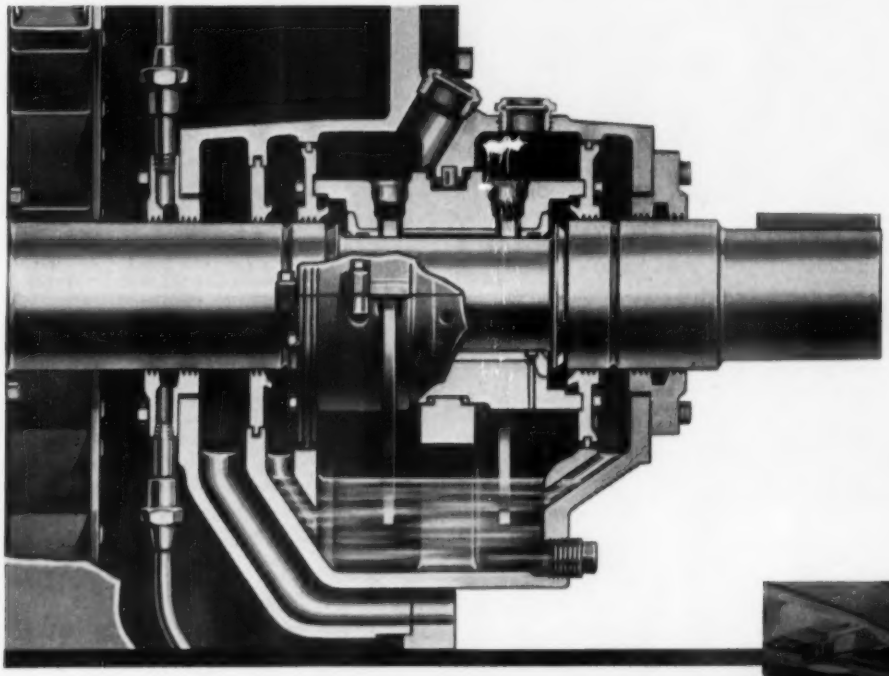
Demand for engineers to attain greater efficiency in heat engines has created a need for metals to withstand the increase in operation temperatures. Steam power plant design engineers are pushing temperatures and operating pressures beyond the safe operating limits of the ferritic steels now in use, and the gas turbine engineers are prepared to design for operation at temperatures higher than the 1600 F limit to which they have been confined for want of materials capable of satisfactorily withstanding higher temperatures of operation. This symposium, sponsored by the General Research Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, attempts to provide a basis of evaluation of a number of metallic materials, including cermets, which have been undergoing study in laboratories both here and abroad, to determine their suitability for higher temperature service. The papers discuss as many as possible of the properties — physical, chemical and mechanical — as well as methods of combating surface deterioration that are affected by temperature.

Titles included in the symposium are:

Some Sheet and Bucket Materials for Jet Engine Application at 1600 F and Higher.
Influence of Boron on Cast Cobalt-Base S-816 Alloy.
The Effect of Heat Treatment and Structure

One of many reasons why **ALLIS-CHALMERS MOTORS** operate dependably for

POWER PLANTS



Allis-Chalmers 1750-hp weather-protected motors driving boiler feed pumps.

Motor Bearing is "extra sealed" with vent

A VENT is seldom a seal . . . but it is in this high speed Allis-Chalmers motor.

Just in case any oil or oil vapor might pass out of the bearing enclosure through the regular seals it can never reach the motor interior. Instead, it enters an annular chamber at the rear of the bearing housing. Pressurized air from the motor fan region is introduced into this pressure chamber and is vented to atmosphere. Positive protection is provided.

Accessible, Too!

Many man-hours in maintenance are saved because the motor can be inspected and maintained without opening or disturbing the bearing itself. It is only necessary to remove the upper half of the split end shield.

For details on these and other features of Allis-Chalmers motors, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS CHALMERS

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5 Features *that give you* EVERLASTING *valve service*

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Straight through flow . . . minimum pressure drop.

2
Quick acting . . . opened and closed with less than one quarter turn of lever.

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Self grinding rotating disc . . . assures tight seal.

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Non-wedging action . . . cannot jam . . . parts move between parallel faces.

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No lubrication required . . . hence no maintenance expense.

Our 50 years experience as valve manufacturers is at your disposal.

Let us help solve your valve problems.

Write for descriptive literature.

EVERLASTING *Valves*

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Engineering Books

continued from page 106

Upon Creep Properties of Nimonic Alloys Between 750 and 950 C.

Stress-Rupture Properties of Income 700 and Correlation on the Basis of Several Time-Temperature Paramaters.

Chromium-Nickel Alloys for High-Temperature Application.

Effect of Rare Earth Additions on the High-Temperature Properties of a Cobalt-Base Alloy.

Creep Rupture and Notch Sensitivity Properties of S-816 Alloy up to 1650 F Under Various Combinations of Fatigue and Static Stress.

Titanium-Carbide Base Cermets for High-Temperature Service.

Titanium-Carbide Products Produced by Infiltration Technique.

High-Temperature Properties of Molybdenum-Rich Alloy Compositions Made by Powder Metallurgy.

Tension and Torsion Tests on Nimonic Alloys at High Temperatures.

Thermal Fatigue Testing of Sheet Metal.

The Development of Zirconium-Rich Protective Coatings and Brazing Materials for Heat Resisting Alloys.

* * *

Atoms and Energy, by H. S. W. Massey. First Edition, 1956. 174 pages, 8½ by 5½, cloth. Published by Philosophical Library, 15 E. 40th St, New York 16, N. Y. Price $4.75.

This is a non-technical account of the developments in atomic physics which led up to the large scale release of atomic energy.

Although the relation of atomic research to atomic energy forms the central subject of the book, special attention has been paid to a description of the nature of the research methods used in modern physics. The final chapter gives an account of the research going on at present in connection with fundamental particles such as electrons, protons, neutrons, Pi-, Mu-, and V-Mesons and neutrinos. The way in which atomic energy is converted to heat in the sun and stars is also described.

The author is Quain Professor of Physics at the University of London, and is also Vice President of the Atom Scientists' Association. He was also head of the group of British scientists working in America on the atom bomb project during the War.

* * *

Trane Refrigeration Manual, published by the Trane Company, LaCrosse, Wisconsin. Size 8½ by 10, 133 pages, including index. Paper binding. Price $1.50.

This is a practical volume on the installation, maintenance, and service of refrigeration equipment used in conjunction with air conditioning systems. Its primary purpose is to aid contractors and other interested tradesmen in understanding and correcting

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Continuing Progress at AI Advances Nuclear Technology For Many Tasks, in Many Lands

Highlighting progress in the many and diversified reactor programs at Atomics International are significant developments in the two major power reactor approaches underway by AI for the Atomic Energy Commission—the Sodium Reactor Experiment and the Organic Moderated Reactor Experiment.

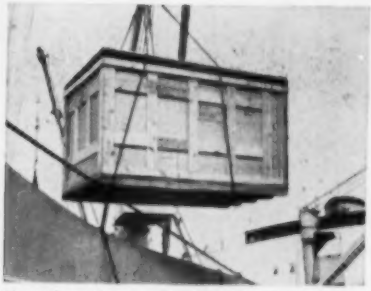
Forecasts Confirmed. On April 25 the 33rd fuel element was introduced into the SRE, and sustained nuclear fission was achieved. The critical loading confirmed earlier calculations. On July 12 heat from the SRE reactor was used by the Southern California Edison Company to generate electricity. This power was fed over utility lines to Edison consumers. Data obtained from the SRE will be used in the design of a 75,000 kw Sodium Reactor power plant proposed for the Consumers Public Power District of Nebraska.

Power Ashore, Propulsion Afloat. Similar studies are starting on the OMRE, recently constructed at the AEC's National Reactor Testing Station in Idaho Falls. This program will assist in the design of two 12,500 kw power stations, one in Piqua, Ohio, and another in a Latin American country. At the same time, the Organic Moderated Reactor is under study as a most promising nuclear propulsion system for the special needs of supertankers.

Reactors for the World. The Armour Research Reactor, first private industrial nuclear facility, is now being followed by a stream of similar research reactors—for Japan, Denmark, West Germany, West Berlin and Italy—constructed, shipped, and installed by Atomics International. AI's latest development is the compact Laboratory Reactor, available on a short delivery schedule at very low cost to meet the need for nuclear training and research in universities and industrial laboratories.

ATOMICS INTERNATIONAL is a leading designer and builder of reactors for America and for the world. For help on your reactor plans, write: Director of Technical Sales, Department PE-74, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, California. Cable Address: ATOMICS.

Critical Moment: On April 25, the SRE achieved sustained nuclear fission. Electricity was generated on July 12.

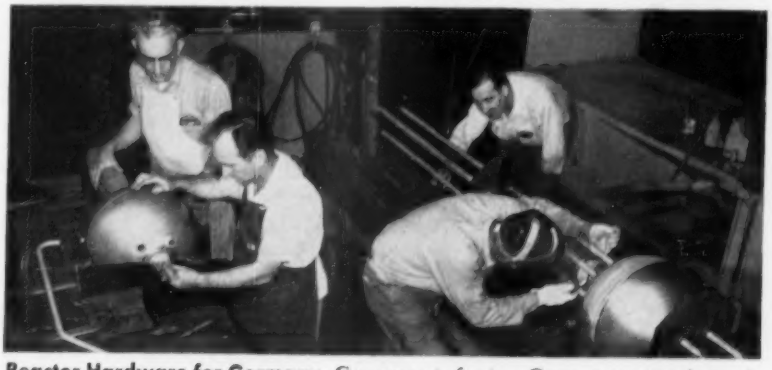


Destination—Denmark: Nuclear reactor components from AI are hoisted aboard a freighter for Copenhagen.

For Land and Sea: A versatile nuclear reactor concept—the OMRE.

Nuclear Research in Japan: Home of Far East's first reactor will be Japan's Atomic Energy Research Institute.

New Laboratory Reactor: Eight-foot-high tank contains fully functional core, coolant and moderator.



Reactor Hardware for Germany: Components for two German reactors in work at ATOMICS INTERNATIONAL.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

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"Lock out" algae scum from water systems

HTH Granular, the *dry* chlorine product, slams the door on algae growths that cause heat transfer loss, produce offensive odors and clog up recirculated-water systems.

HTH Granular contains 70% available chlorine. When added *directly* to water, it dissolves immediately to release a fresh hypochlorite solution that provides sure, fast algae kills in condensers, spray towers, cooling ponds, reservoirs and air-conditioning equipment.

One ounce of HTH per 1000 gallons of water is usually enough to control algae growths. Because algae growths form slowly, in most cases only a periodic "shot" treatment with HTH is necessary. This varies, of course, with the nature and condition of the specific water supply.

Safe, easy-to-store and easy-to-use, HTH Granular is packed in 100-lb. drums and in cases of nine 5-lb. cans. Your supplier can answer all your questions about HTH, or if you prefer, just write.

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Engineering Books

continued from page 108

the multitude of problems encountered in installing, operating, and servicing refrigeration equipment. This is a complete revision of the original publication which has been made to incorporate data on the new Trane compressors.

Information in this book applies specifically to equipment manufactured by the Trane Company but it contains also much general information of importance to operators of all types of refrigeration equipment.

★ ★ ★

Air Conditioning and Engineering, Second Edition, edited by the engineering staff of American Blower Corporation. Size 6 by 9, 260 pages, including index. Cloth binding. Published by American Blower Corporation, Detroit, Michigan. Price $6.00.

The subject matter in this volume has been prepared by specialists; each chapter reflects the individual style and manner of presentation of its author, which adds to the value of the completed work. The book includes fundamental principles, laws, and tables, determined experimentally or mathematically; simple calculations in considerable detail; and a compilation of data based on the experience of authors, their predecessors, and contemporary engineers throughout the country. This is a practical book, and readers will find the information it contains to be useful in the solution of air engineering and power transmission problems. The book is divided into seven sections; these are: Air Conditioning and Refrigeration, Heating and Ventilating, Industrial Processes, Mechanical Draft, Dust Collection and Control, Fluid Drive Power Transmission, and lastly, Tables and Charts.

Although this book is published by a manufacturer of equipment and naturally draws upon their design and illustrations, the data it presents are useful and practical.

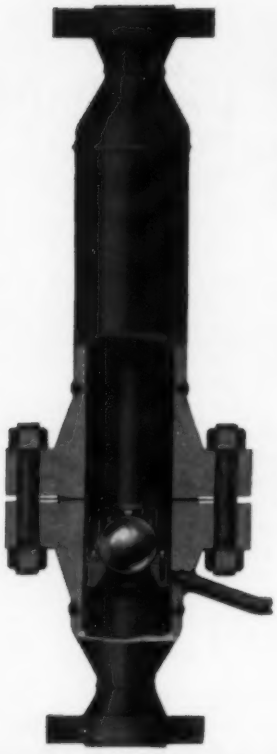
★ ★ ★

Mechanics for Engineers, by Ferdinand P. Beer, and E. Russell Johnston, Jr. Size, 6¼ by 9¼ in., 673 pages, cloth binding. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y. Price $8.00.

This text was prepared for the standard courses in Statics and Dynamics taught in the sophomore or junior years of college, and was used in preliminary form for several years at Lehigh University.

Objective of the authors is to provide complete coverage of the field. One of the characteristics of the approach is that distinct chapters are devoted to the dynamics of particles and to the dynamics of rigid bodies. This approach permits simple, practical applications at an early stage, postponing the introduction of the more difficult concepts.

New concepts have been simply stated and every step explained in detail. The fact that mechanics is essentially a deductive science



Variable-orifice desuperheater for precise temperature control

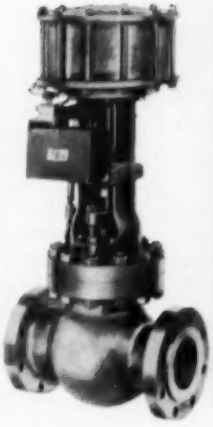
Using a weighted steel ball for controlling the orifice opening, the new Copes-Vulcan Variable-Orifice Desuperheater assures close control of reduced steam temperatures regardless of load variations. Mixing and vaporization of cooling water and steam are so complete that reduced steam temperature can be held constant only 20 feet downstream from the desuperheater outlet — even over a 50-to-1 load range.

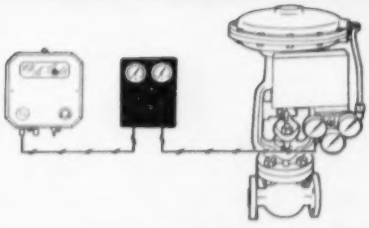
Unique design eliminates the need for excess piping, atomizing steam, spray nozzle or glands. No excess water needs to be removed from the stream.

The Variable-Orifice Desuperheater is one of a complete line — each type engineered to meet particular operating conditions. Copes-Vulcan designs each station to meet individual requirements. Write for details.

Two basic valves built to handle more jobs

With the new diaphragm-actuated Type CV-D and piston-actuated Type CV-P valves, Copes-Vulcan offers new simplicity in design, wider flexibility in application for remote control service. Type CV-D is reverse or direct acting in sizes up to 14-inch at unlimited pressures. Type CV-P is ideal for highest valve-operating force, and precise positioning. Write for Bulletin 1027.





Pneumatic control stations simplify performance . . . maintenance

This Remote-Set AMS-4 Station is used with pneumatic stacked-diaphragm controllers . . . provides adjustable set-point loading or independent manual operation. Copes-Vulcan builds auto-manual stations in Standard, Remote-Set and Cascade types, and Manual Loading and Miniature Stations. Write for Bulletin 1031.

Patent applied for

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

For more data circle 558 on Post Card

GILSULATE®

Specially sized, selected and blended Gilsonites

...the natural insulation that is the answer to underground piping problems

To Torture Any Thermal Insulation – Bury It! The severest service test of any thermal insulation is burial underground. High humidity, heavy structural loading, a chemically and organically active environment, thermal cycling and pipe movement, and vibration – all these work to break down the insulation.

Why Buried Piping Corrodes: External corrosion of buried piping is variously caused: *Electrolytic attack* occurs when stray direct currents find their way from a piping system to the earth, at which point pitting occurs on the pipe surface. *Galvanic attack* results from current generated when metal touches certain types of soils. *Chemical attack* may include damage by water in liquid or vapor form, earth salts, chemicals from industrial or organic wastes, or by chemicals in various insulating materials.

Gilsulate solves an old problem by surrounding the piping with a material which is a dielectric, is chemically neutral and stable, is a *natural* insulator and which, in the case of buried hot piping, also forms a good vapor barrier.

No other insulation protects buried hot piping completely! Gilsulate is the only insulation which can provide the three *vital* means of protection, and also withstand the destructive forces of burial in the earth. It is physically and chemically stable. It will not dissolve, crush or rot. It is not rigid; therefore, ground and pipe movement will not destroy its effectiveness.

8 Reasons to use and specify GILSULATE

1. IT IS A NATURAL INSULATION

Gilsulate is mined, crushed, screened and blended from pure Gilsonite mineral, a unique hydrocarbon found only in eastern Utah. No chemical or other physical change is made in the natural mineral. It is a *natural* insulation. Gilsonite is mined in an exceptionally pure state with virtually no trace minerals or foreign materials. Gilsulate is specially sized, selected and blended Gilsonites.

2. IT PROTECTS PERMANENTLY

The Gilsulate system solves the problem of insulating underground hot piping permanently – and at low cost.

3. IT CANNOT DETERIORATE

Chemically inert and stable, Gilsulate cannot change with time, moisture or soil. It is impervious to mold, fungus, bacteria, rodents, plant growth and soil chemicals. It has lain unchanged in the earth for millions of years.

4. IT IS PACKAGED FOR EASY HANDLING

Gilsulate is supplied in 2½ cu. ft. sacks. Shipping, storage and handling at the job site are easy. No bulky, heavy units requiring cranes or special tackle – practical packaging for palletized loading or manhandling to hard-to-reach piping locations.

5. ...AND IT IS ADAPTABLE AT JOB SITE

Gilsulate needs no pre-cutting, mixing, assembling or fitting. Last minute job site changes in the piping layout or arrangements will not demand special fittings or changes in the insulating equipment or methods.

6. EASILY INSTALLED

Gilsulate all but installs itself. Just pour it on... tamp it down... heat the piping... backfill. The Gilsulate fuses to form a plastic protective sheath around the pipe.

7. NO SPECIAL FORMING OR MATERIALS NEEDED

Gilsulate adjusts itself to pipe expansion; provides its own vapor barrier. No hand fitting is needed; no special vapor barriers need be installed. Usually, the trench walls and floor are the only forms needed. Sheet metal or wood slip forms may be used if trench is cut wider than the insulating envelope desired. For a single pipe, or complex multiple piping system, *installation is simple.*

8. PIPING ALWAYS EASILY ACCESSIBLE

Gilsulate structure gives the only underground piping system which can be opened and re-installed with only pick and shovel. Alterations and additions to Gilsulate-insulated systems demand no more skill than does altering a fully exposed piping system.

Do you receive
PIPE INSULATION NEWS?
Ask to be put
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Engineering Books

continued from page 110

based on a new fundamental principle has been stressed. However, since the learning process is largely inductive, simple applications have been considered first. A large number of optional sections have also been included.

The text has been divided into units, consisting each of one or several problems to be assigned. Each unit corresponds to a well-defined topic and generally may be covered in one lesson. Answers to all even-numbered problems are given, and the test is profusely illustrated.

* * *

Basic Electrical Engineering by A. E. Fitzgerald and David E. Higginbotham, second edition. Size, 6¼ by 9¼ in., 540 pages, cloth binding. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y. Price $6.50.

Three main objectives are emphasized in this revised edition: The authors have concentrated on making the subject more easily taught and understandable; they have given full recognition to the importance of modern control and measurement techniques, and have specifically incorporated recent developments and concepts in circuit theory, machinery and electronics. New concepts are introduced in a more gradual manner and fuller explanations are presented.

Devices and concepts newly introduced are magnetic amplifiers, transistors, self-balancing recorders and controllers, phase-sensitive modulation and demodulation, control amplifiers, d-c and a-c control motors, and transfer-function and frequency-response analysis.

Starting with simple statements of the elementary electrical principles resulting from classical scientific experiments, the authors then present the fundamental methods of analysis which are of greatest importance in these fields. The number of examples with complete solutions is increased in this second edition, and a wide variety of tested problems are included.

* * *

Trigonometry Refresher for Technical Men, by A. A. Klaf. 1956 edition, 629 pages including index, paper bound, 5⅜ by 8 in. Published by Dover Publications, Inc, 920 Broadway, New York 10, N. Y. Price $1.95.

First published in 1946, this handy questions-and-answers text covers the most important aspects of plane and spherical trigonometry. The present edition is unabridged and unaltered, includes 913 questions answered for the student, 1738 problems to test progress, answers to odd numbers, 494 figures, and 24 pages of useful formulae and tables.

The book's second edition gives 199 pages to the application of plane trigonometry to special problems in various fields of engineering, navigation, surveying, elasticity, and architecture. Practical methods are offered for saving time in numerical calculations.

* * *

Calculus Refresher for Technical Men, by A. A. Klaf. 1956 edition, 431 pages including index, paper bound, 5⅜ by 8 in. Published by Dover Publications, Inc, 920 Broadway, New York 10, N. Y. Price $1.95.

The first part of this book covers simple differential calculus. The second part covers fundamental ideas of integration, areas and volumes, mean value, successive and partial integration, double and triple integration. In all cases the author stresses practical aspects.

A 50-page section illustrates the application of calculus to specific problems of industrial engineering, civil and nautical engineering, electricity, stress and strain, elasticity and similar fields.

In all, 756 questions are answered and 566 problems included. There are 36 pages of useful constants and formulae for ready reference. The book is a companion work to the author's Trigonometry Refresher for Technical Men.

* * *

Thermal Power from Nuclear Reactors, by A. Stanley Thompson and Oliver E. Rodgers. First Edition. 229 pages, 6¼ by 9½ in., cloth. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York, N. Y., 1956. Price $7.50.

This is the first book on atomic reactors written from a mechanical engineer's standpoint. Stressing a design approach, the work discusses problems of reactor development which confront the engineer in nuclear power plants. Engineering problem-solving techniques such as numerical and dimensional analysis are applied to these problems, and workable design criteria are evolved. Some of the problems of reactor development treated in this manner are: thermal stresses,

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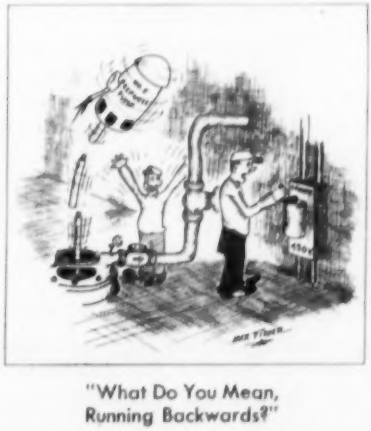

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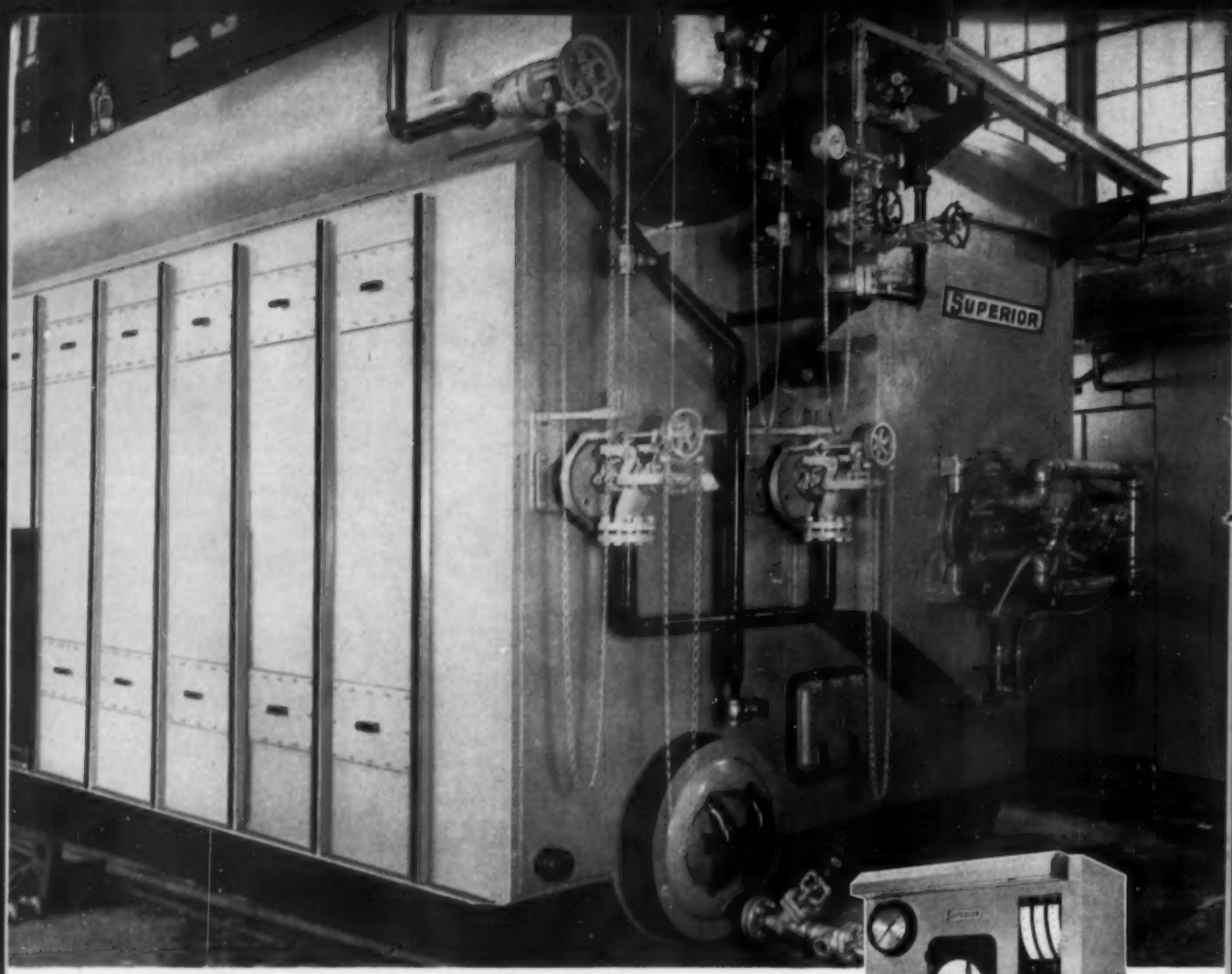

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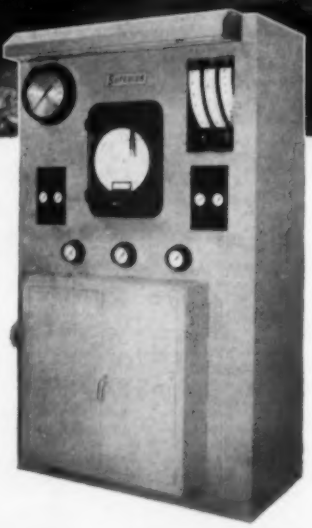

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ELECTRICAL EQUIPMENT

201 Testing Instruments — Bulletin 19–57, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

202 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

203 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

204 High-Power Batteries — Bulletin CP-538/55 covers company's line of Hi-Power batteries for use in the control-switchgear, emergency lighting and auxiliary power fields. Includes data on battery ratings and capacities, details of design and construction, dimensions, weights and types of containers. C & D Batteries, Inc.

MECHANICAL POWER TRANSMISSION

205 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multicolor tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

206 Internally Geared Power — Featuring latest design improvements in gearmotors and embodying 60 multicolor illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ¼ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion

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of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.

207 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use. American Blower Corp.

PUMPS AND PUMPING

208 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

209 High Pressure Pumps — Eight-pp Catalog HP-1254 describes and illustrates company's Series HP controlled-capacity pumps for pressures to 35,000 psi and capacities to 2000 gph. Selection charts are provided for models with crank arm drive and yoke drive, along with application suggestions. Series HP pumps include some 298 models in three basic pump frame sizes for 2-, 3-, and 4-in. pump strokes. Specifications, design features discussed. Philadelphia Pump & Machinery Co.

210 Non-Clog Pumps — Bulletin 121MV features Mono-Vane single passage impeller pumps designed for handling heavy settleable solids, long stringy solids, effluent etc. Both horizontal and vertical types are presented along with specifications. Mono-Vane impeller is described in detail, and various models of the pumps are pictured. Aurora Pump Div., The New York Air Brake Co.

211 Flow Control — Twelve-pp Catalog 800 describes four basic models of precision proportioning pumps for uses requiring accurate and positive proportioning of flow in range of 0 to 730 gph. Materials of construction, capacities and pressures are shown for each. Diaphragm valves are discussed and their features noted. A section on plastic valves and diaphragms features those for temperatures to 300 F, and includes diaphragm material chart covering selection for use with air, water, corrosives, slurries, liquids, gases. Hills-McCanna Co.

BOILERS, GENERATORS

213 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

214 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes

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and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

215 Hot Water Boilers — This 20-pp brochure describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

216 Automatic Boilers — Bulletin BE-4 describes operation and advantages of Continental automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Shows cutaway view of boiler construction; illustrates hinged doors and method of injecting air. Boiler Engineering & Supply Co., Inc.

217 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

218 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data and dimensions for the units. Preferred Utilities Mfg. Corp.

219 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of design features are included. Foster Wheeler Corp.

220 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

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FUEL BURNING EQUIPMENT

221 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

222 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

223 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

REFRACTORIES, INSULATIONS

224 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

225 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

226 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four

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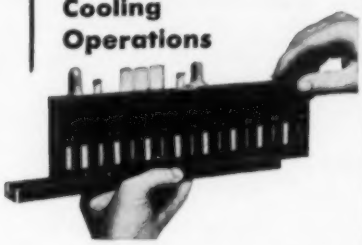

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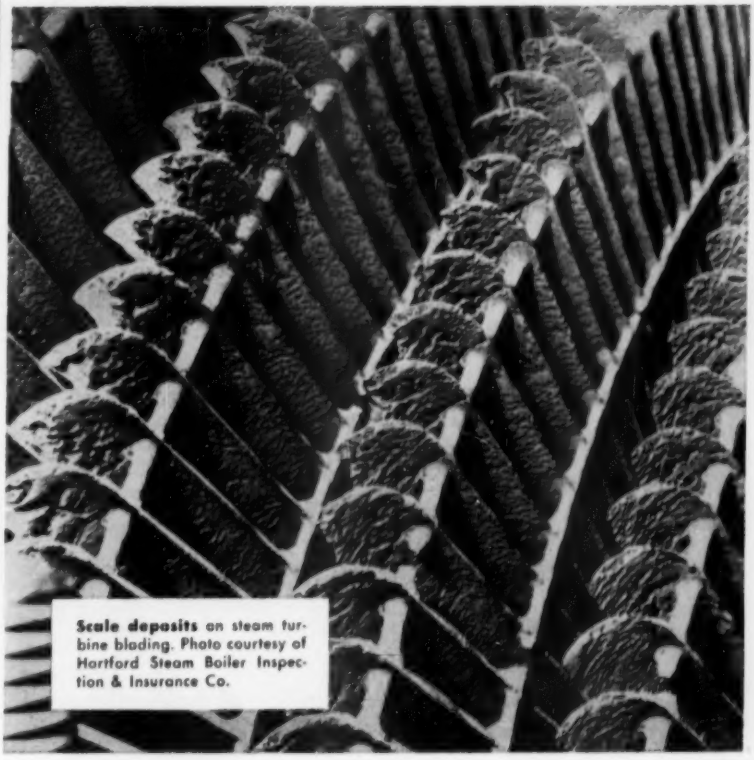

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

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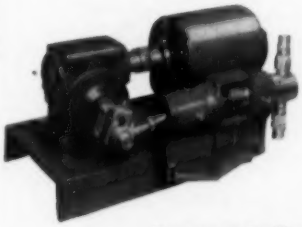

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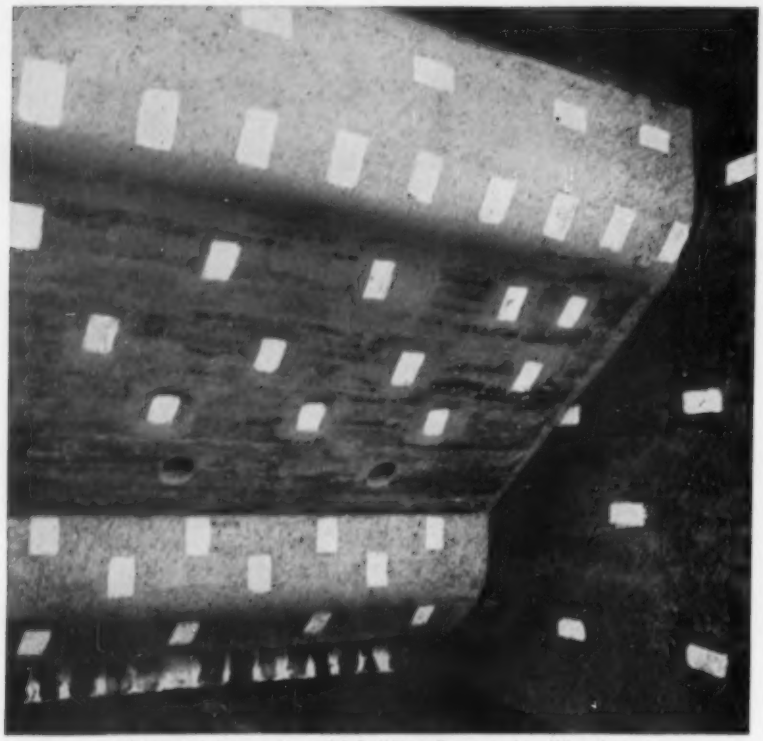

Photo and data courtesy of J. D. Wilson Company, Inc., Milwaukee

Laclede Super Plastic Refractory Helps Cudahy save $250,000

Here's how Cudahy Brothers Company saved the cost of a new boiler. Engineers rejuvenated an old 607 hp., 4 drum boiler by opening its bottled-up furnace and designing a new arch. The new furnace walls and arch —of Laclede Super Plastic Fire Brick—increased furnace volume by over one-third.

Output soared from 37,000 lbs. of steam to 50,000 lbs. hourly. The old boiler now operates at 150% to 175% of rated capacity, and works continuously except for short cleaning periods. Formerly, low efficiency and high refractory maintenance limited operation to six weeks a year. Now it competes with Cudahy's newest steam generator. Maintenance was zero for the first three years and has been negligible since then.

This potent combination of good engineering and Laclede refractories gives older boiler settings new life. It sends new ones off to a flying start. For more information, write Laclede-Christy Works, Refractories Division, H. K. Porter Company, Inc., St. Louis 10, Mo.

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typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

227 Duct Insulation — Engineering data and application instructions for company's semi-rigid, spun mineral wool duct insulation are presented in this informative bulletin. Thermal and sound absorption characteristics are presented in tabular form and physical, chemical, mechanical properties given. Baldwin-Hill Co.

228 Underground Pipe Insulation — This illustrated bulletin discusses the problems of underground pipe insulation and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

WATER CONDITIONING

230 On Biological Fouling — Eight-pp Technical Paper 134 discusses biological fouling in recirculating cooling water systems. Covers common problems of slime and algae in this system and points out how deposits of biological origin can interfere with heat transfer. A discussion of control agents for overcoming this situation and selection of proper toxicant is included. Betz Laboratories, Inc.

231 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

232 For Boiler Protection — Scav-Ox, a 35 per cent hydrazine solution for removing dissolved oxygen from boiler feedwater, is described in this 16-pp illustrated booklet. It covers in detail the use of the solution for protecting low, medium and high pressure boilers, discussing determination of dosage, recommended methods of application, testing methods for hydrazine, and properties and handling of the material. Comprehensive operating data given. Olin Mathieson Chemical Corp.

Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on pages 115–116. We'll do the rest!

233 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising the pH value of the condensate. The Bird-Archer Co.

234 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains

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why direct treatment is convenient, economical. National Aluminate Corp.

235 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

236 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

237 Feed Water Deoxygenation — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, storage are covered. Fairmount Chemical Co., Inc.

238 Carbon Dioxide Measurement — Technical Paper 133, 16-pp, discusses determination of CO_2 in water by conductivity measurements. Describes a new method developed for the determination of carbon dioxide which is applicable to analysis of waterside deposits, treatment chemicals and organic carbon in water. Betz Laboratories, Inc.

239 Valveless Filter — Operation of company's automatic valveless filter is described in this 8-pp illustrated bulletin. Applications and typical operating conditions are detailed and diagrams and photos are included. The Permutit Co.

240 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and non-deaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

241 Data on Deaeration — This series of bulletins presents company's line of deaerating equipment for removal of dissolved gases from boiler feedwater etc. Publication 4651 describes Jet-Tray deaerators; No. 4652 covers tray-type units. No. 4653 deals with cold water deaerators used primarily to reduce or eliminate corrosion of piping systems, heat exchangers. No. 4654 describes a surface-type deaerating hot water heater for commercial and institutional use. No. 4663 covers self-contained Uni-Pac deaerators for small and medium size power plants. No. 4635, 12 pp, on atomizing deaerators, details deaeration by atomization and its applications. Cochrane Corp.

242 Water Softeners — Twenty-pp Bulletin 1855-A describes this manufacturer's Accelator Hot-Flow softeners and Hot-Flow softeners of the slurry retention type covering advantages and applications of both. Describes and pictures reaction tank auxiliaries and associated equipment,

and provides illustrations diagramming some typical installations. Sections of booklet are devoted to discussion of boiler feedwater treatment in general, limitations of hot process softening, and the chemistry of hot process treatment. Infilco Inc.

TUBING AND ACCESSORIES

244 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

245 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

246 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

248 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

249 Diaphragm Motor Valve — Bulletin J-170 describes outstanding features of company's diaphragm motor valve designed for accurate control of pressure, temperature, rate of flow, and liquid level. Cutaway view showing component parts is included, along with data on materials of construction, capacity tables, and flow diagram. The Jordan Corp.

251 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

252 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

253 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's

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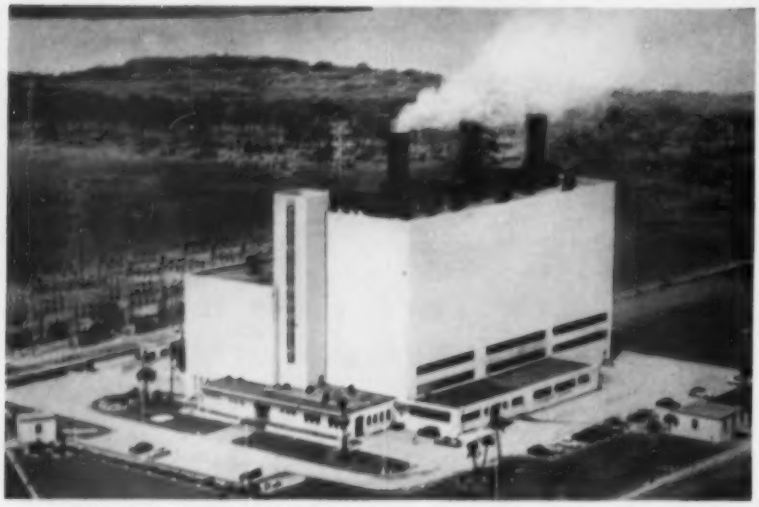

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quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

254 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

255 Valve Chart — Form 194R, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio, Injector Co.

256 Bronze and Steel Valves — Catalog 200, 80 pp, describes company's bronze and steel valves, including globe, angle, gate, Flocontrol and other types applicable to power, petroleum, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings are included. The catalog is profusely illustrated with photos, cutaway views and dimensional drawings. Manning, Maxwell & Moore, Inc.

257 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

258 Trap Service Guide — To promote better trapping practice, pocket-size 32-pp Bulletin 7511 offers practical tips on installation, testing, and maintenance. Chapters are devoted to inspection and repair, trouble shooting, parts identification. Capacity charts are provided, also tables showing interchangeability of company's trap parts. Other sections deal with strainers, check valves, automatic trap drains. Armstrong Machine Works.

259 Steam Trap Selector — Twelve pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

260 To Get at Those Valves — This little folder describes a sprocker rim with chain guide. The rim adjusts to fit all valve wheels. Babbit, Steam Specialty Co.

PACKINGS, SEALS

262 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

263 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the

multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

264 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

INSTRUMENTS, CONTROLS

265 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

266 Instrument Panels — Power and process plants can choose instrument and control panels to meet individual specifications from six standard designs described in 16-pp Product Specification G71-7. Complete specifications are furnished, as well as information on supports and mountings for tubes, wires and equipment, instrument mounting dimensions, and dimensions of standard instrument and control panels. Bailey Meter Co.

267 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

268 Indicating Flow Meter — Bulletin 18-A, 22-pp, discusses advantages, construction and operation of company's Type H indicating flow meter. Presents technical data on the principles and theory of fluid measurement and discusses orifice type meters and orifice meter principles. Offers examples of flow rate calculations. Schematic drawings and diagrams, tabulated technical data and specifications are included. The Meriam Instrument Co.

269 Steam Calorimeter — This bulletin discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of unit. Ellison Draft Gage Co., Inc.

270 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features, illustrates construction details through photos and drawings. Diamond Power Specialty Corp.

271 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance tem-

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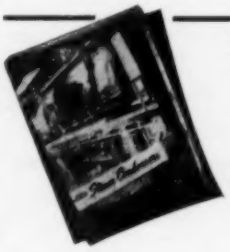

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perature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

272 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

273 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

OTHER EQUIPMENT

274 Metal Laminates — Types of metal laminates, metals which can be laminated, and use in heat exchangers, electronics and other applications are detailed in this illustrated 8-pp bulletin. Advantages and properties are described, and size data given. Bridgeport Brass Co.

275 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

Postage-free cards for ordering catalogs are on page 115. You may also use the cards to order literature mentioned in the ads.

276 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

277 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

278 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

279 Water-Cooled Stoker — Design and operating advantages of the Vibragrate Stoker are outlined in this illustrated bulletin. A large cutaway view details component parts of the stoker and explains operating features. Other drawings show installations. American Engineering Co.

Advertisement

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P. R. Sandwell, President of Sandwell and Company Incorporated of Seattle, announces the appointment of Mr. Arthur Winiger of Zurich, Switzerland as a director. Mr. Winiger is the Managing Director of Electro-Watt Electrical and Industrial Management Co. Ltd., of Zurich. The Sandwell organization is associated with Electro-Watt in the electric power field.

Mr. Winiger is internationally recognized in the hydro-electric power development and atomic energy fields. He is a member of the Swiss National Committee of the World Power Conference, Vice-Chairman of the Board of Reactor Ltd., Wurenlingen, Switzerland, and Chairman of the Board of Atomelectra Ltd., Zurich.

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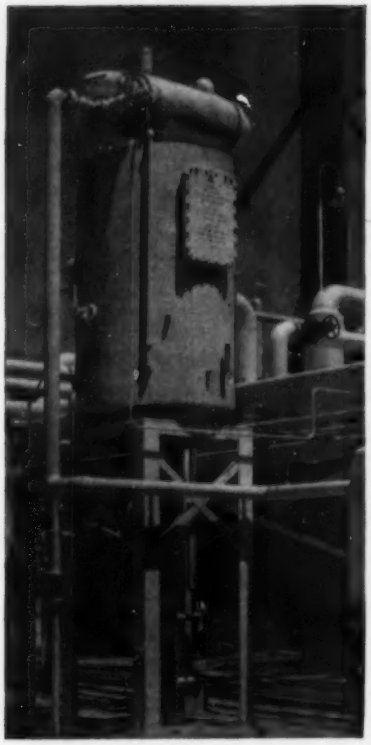
How to solve a feed water problem



A Texas oil refinery needed a packaged feed water heater rugged enough for exterior installation, and capable of delivering water at specified temperature even with 1" or more of encrustation on tray surfaces. Selected for the job was the Stickle unit shown above. Extra deep trays force water to flow irregularly in a thin film, depositing solids and releasing noncondensable gases. Trays cannot overflow; are easily removed for cleaning. Open coils bring feed water into direct contact with steam, immediately transmit heat to water. Condensed steam is not wasted. It provides one-sixth of boiler feed supply. There's a Stickle feed water heater for practically every need. Capacities 3,000 to 300,000 lbs. per hr. Stickle has built heaters since 1905; is well equipped to solve your feed water problem. Write for free bulletins.

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280 On Coal Burning Plants — Presented in this illustrated 20-pp booklet, "More and more firms are burning coal the modern way . . ." are eight case histories of notable coal burning plants. They include industrial, commercial and institution power plants, both modernization and new construction. Economy and other advantages of coal as a fuel are stressed. Bituminous Coal Institute.

281 Refrigeration Condensers — Engineering data on a complete range of sizes and types of refrigeration condensers are featured in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, ammonia condenser-towers, freon condensers and freon condenser-towers. Selection data, dimensions, dimensional diagrams and tables of pipe sizes given. Henry Vogt Machine Co.

282 Ejector Data — This 12-pp bulletin presents company's steam jet air ejectors designed for efficient, low cost air removal from condensers. Illustrates basic ejector assembly, and discusses principle of operation. Single- and multi-stage units are shown. Also described are steam jets for special services and air ejector accessories. Engineering data pertinent to ejector application in power plants, process plants and evaporators included. Condenser Service and Engineering Co., Inc.

283 Shredders, Crushers — Bulletin 257 describes and illustrates hammermills and shredders, rolling ring and special crushers for reducing chemicals, minerals, ceramics, and other materials including wood waste. Discusses construction features of the line and includes dimensions. American Pulverizer Co.

284 Tractor Shovel — This 8-pp bulletin deals with construction and application of company's HD-11G tractor shovel, a 2¼-yd capacity unit with several work-speeding features. Transmission, hydraulic system, shovel assembly and other components are described in detail. Specifications included. Allis-Chalmers Mfg. Co.

285 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multi-purpose soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures are discussed. Sinclair Refining Co.

286 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multi-stage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

287 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

288 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing. Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers, etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

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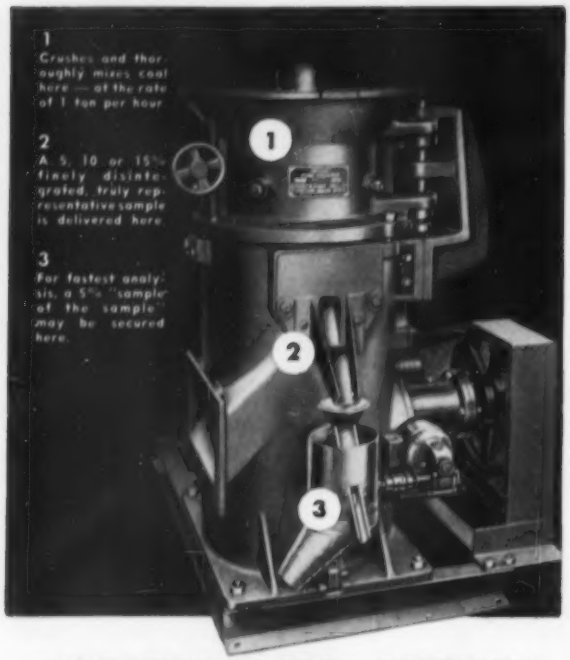
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Crushes and thoroughly mixes coal here — at the rate of 1 ton per hour
2
A 5, 10 or 15% finely disintegrated, truly representative sample is delivered here.
3
For fastest analysis, a 5% "sample of the sample" may be secured here.
1
2
3

STURTEVANT COAL SAMPLER

with New Automatic Splitter

It's a fact! Big users of coal and coke know the true B.T.U. value of deliveries before moisture has a chance to evaporate . . . thanks to the speedy crushing, homogenizing and proportioning actions of the Sturtevant Automatic Coal Sampler and its Automatic Splitter. So, they get what they pay for . . . and increase boiler efficiency in the bargain.

Handles a ton an hour! The Sturtevant Automatic Coal Sampler takes 3" or smaller coal or coke and crushes it to 6 mesh or finer. Sample spout takes off 5, 10 or 15% of the finely crushed homogenous mixture, as desired. Then, the optional Automatic Splitter takes a 5% "sample of the sample."

"OPEN-DOOR" DESIGN

provides "One Man, One Minute" accessibility for all cleaning and maintenance — an exclusive Sturtevant feature that saves valuable down-time.

Want more information? *Write for all the facts about the Sturtevant Automatic Coal Sampler — the tested shortcut to accurate B.T.U. analysis.*

STURTEVANT

MILL COMPANY

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Proper combustion of fuels is dependent upon draft—Ellison Gages show you the draft condition at all times—they are easier to read, accurate, dependable.

Straight-line and Dial types—bell actuated and diafram actuated—built for durability and accuracy. Exclusive features such as transluscent glass scale, unitized mechanism that can be slipped out of case, practical illumination, nonfogging and dust sealed. A bank of Ellison Straight-Line Draft Gages at the South Shore Destructor Plant, Brooklyn, N.Y., is shown. Send for Bulletins 122 and 124.

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Engineering Books

continued from page 113

transient behavior of reactors, and distribution of gamma rays and neutrons.

The introductory chapters give a concise review of nuclear fission and a general description of nuclear reactors, helpful in orienting the engineer to current thought of physicists. In short, this book fills the need of men with engineering backgrounds as a guide in reactor design, and it also gives the physicist a picture of the engineering implications of nuclear fission.

A. Stanley Thompson conceived the idea of writing this book while teaching a course in reactor engineering design at the Oak Ridge School of Reactor Technology where he was chief development engineer for the Oak Ridge National Laboratory. Oliver E. Rodgers contributes to the book his wide experience in the development of rotary machinery for producing power. His experience with steam turbines, turbojet engines, aviation and industrial gas turbines applies well to discussions of power obtained from nuclear sources.

★ ★ ★

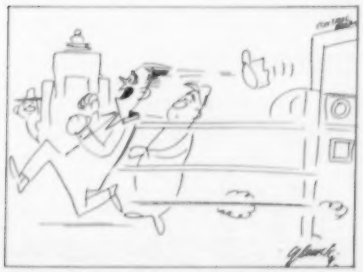
Panel Discussion of Pyrometric Practices, ASTM Special Technical Publication No. 178, 78 pages, heavy paper cover. Size 6 by 9 in. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $1.50.

Much interest centers in defining the precision of temperature measurement and control which can be recommended or specified in high-temperature test work. The Panel Session, organized by the Test Methods Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, discusses work in this field, and is concerned with the ASTM recommended practices on high-temperature testing of metals, E 21, E 22, and E 85. Introduction is by J. W. Freeman and papers included are:

Thermocouple Immersion Errors.

Summary of Pyrometric Procedure Employed by One Company in Creep-Rupture Testing and An Analysis of Results Obtained.

Creep and Rupture Test Pyrometry.



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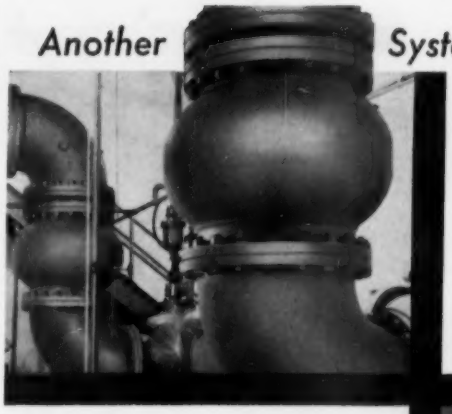
Another System Made



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Here is protection against damage from surge pressures . . . the means to eliminate resulting water hammer. They operate instantly when flow reversal starts or when flow is zero. Write for descriptive Bulletins.

WILLIAMS-HAGER Silent CHECK VALVES

Write for Bulletins No. 654 on the Valves; No. 851 on Cause, Effect and Control of Water Hammer

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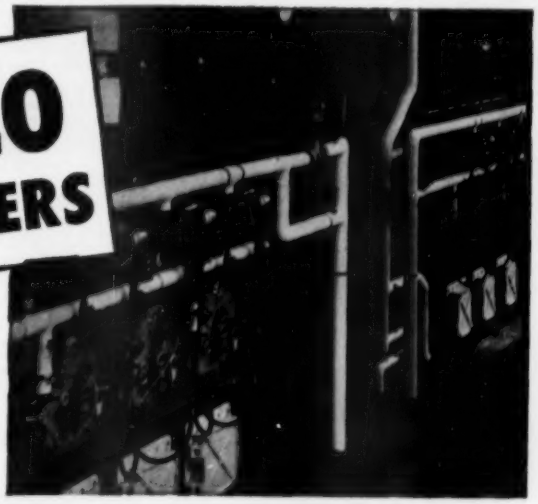

Steam or mechanical atomizing...1 to 1000 gallons per hour

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ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

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KOR *FOR OIL*

A superior sludge dispersant; plus a combustion catalyst which keeps the entire fuel oil system clean (tank to stack inclusive) without labor involved. Obtains more steam or more heat with less oil at less cost than ever before.

FOR COAL **OXI**

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THINK of **Babbitt**

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SPROCKET RIM
with Chain Guide

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- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost only cost
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- Hot galvanized, rust-proof chain available for all sizes
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- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

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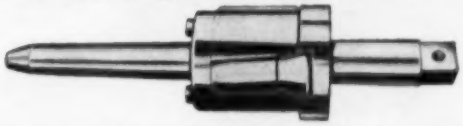
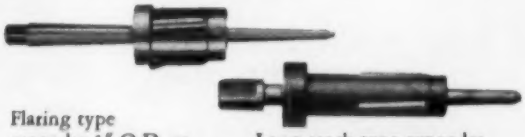
Designed to deliver maximum power at the most efficient cutter head speeds while negotiating sharp bends, the Model ECT Air Cleaners are excellent for cleaning curved boiler tubes from 2½" to 4½" O.D.

Self-feeding tube expanders



Wilson Model 38 tube expanders are self-feeding and parallel expanding. They are of the single flare roll type. Available for tubes 1" O.D. to 4½" O.D. with various roll lengths for tube seats ¾" and up.

Model E Expanders



Flaring type expander 1" O.D. to 4½" O.D. tubes, ½" to 2" tube seats

Long reach type expander 1" O.D. to 4½" O.D. tubes, 2½" to 5" tube seats

Right angle bevel gear drive

This Wilson bevel gear drive is expressly manufactured to meet continuous and heavy duty service conditions. The one piece all steel body is extremely rigid and not subject to distortion. The maintenance of perfect gear alignment is assured with consequent long service life.

Write today for your copies of Wilson Tube Cleaner catalog No. 77 and Wilson Tube Expander catalog No. 88.

Representatives in principal cities
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TYPE J—1 TO 30 H.P.
Rerated Frames 182 to 326U

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For complete information about TOTALLY-ENCLOSED MOTORS.

U.S. Electrical MOTORS

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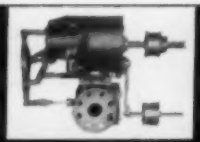

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Let Troy Steam Engines and Generators produce dollar-saving "BY-PRODUCT POWER" from steam available for processing or heating. You can use this low-cost power for many operations in your plant, even against high back pressures!

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Generating Electrical Power

Mechanically Driving stokers, pumps, fans, compressors and other equipment.

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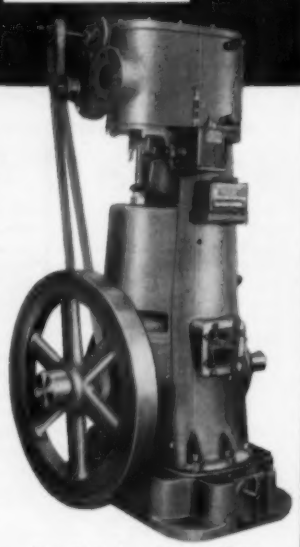

Type E. Engine, 12.5 to 100 HP.

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Cross section of special Chapman Valve of the type used on the primary coolant loop of the first atomic submarine, the Nautilus. Operates at 2000 lb. pressure at 600°F.

Since the days when a 300 pound steam valve was considered an important development, the Valve Industry has added many higher standard pressure ratings. New and special valves have also been developed and built by Chapman, including primary coolant valves for the Nautilus; Mark I and II; A1W and S5W Valves for the first large ship reactors; valves for the Dresden reactor; and many others.

Chapman Valve, since its organization in 1875, has kept in step with developments in the Power Industry; meeting promptly and efficiently the demands for valves to withstand increased pressure and temperature specifications. The Chapman line today covers a complete standard range to 2500 lb. and special designs for super-critical pressures.

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INDIAN ORCHARD, MASSACHUSETTS

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HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 3 OF A SERIES)

Precipitation Equipment

Basically, precipitation equipment converts water impurities to the form of large, dense, suspended particles; then it separates these particles from the water.

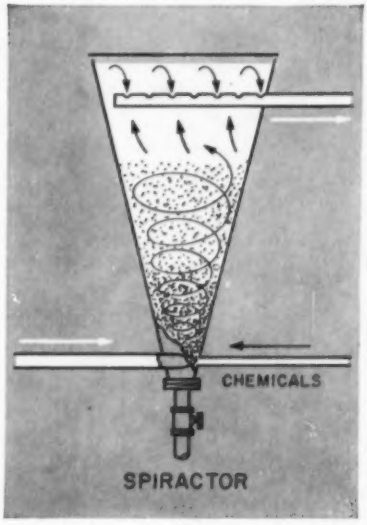
The first step is accomplished with chemicals. Hardness, for example, is precipitated by adding lime (and soda ash, if required). The precipitated hardness and other suspended impurities such as turbidity or oxidized iron and manganese are made to coalesce into larger particles by adding alum or iron salts. These salts also form their own dense, floc-like precipitate which absorbs the suspended material to form even larger particles.

The insoluble particles must then be separated from the water. Early methods used settling basins where precipitates settled slowly as the water flowed through, requiring 2 to 4 hours or longer detention time. Modern equipment keeps precipitates in suspension to serve as nuclei on which fresh precipitates form. This results in larger, denser particles that absorb more of the fine particles and are more easily separated from the water.

PRECIPITATOR for removing hardness, turbidity, color, iron, manganese.

Chemicals are mixed with influent at A. As water flows downward through zone B, precipitates form, "seeded" by recirculated sludge. At C, floc has formed a sludge-blanket filter suspended by upward motion of the water. Excess sludge is concentrated and periodically drawn off.

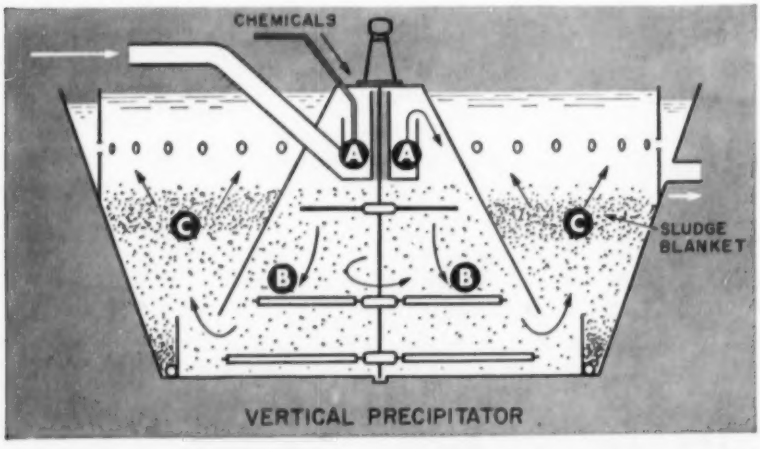
Because of short detention time, capacity is about 4 times that of conventional coagulation and settling basins of the same size. Basic designs include vertical types as illustrated, vertical types for installation in existing tanks, horizontal types built into new or existing concrete basins and smaller "package" types for bottling plants, etc.



SPIRACTOR® for softening clear hard water.

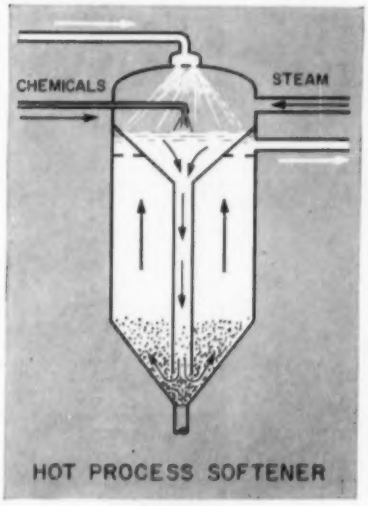
The water, lime (and soda ash if required) enter at bottom of cone. The treated water rises with a swirling motion and suspends a bed of fine granules of calcium carbonate or other catalyst which speed softening reactions. The precipitated hardness deposits on the granules which become heavy and work down to the bottom of the cone where they are drawn off then easily dried and dumped. The softened water rises above the bed of granules to the outlet.

Provides very high flow rates in relation to its small floor space. Detention period: 8 to 10 mins. Recommended for municipal or cooling water.



HOT PROCESS SOFTENER for removing hardness and silica from boiler feedwater.

The water is first heated to within a few degrees of boiling by spraying through steam. Then it is mixed with softening chemicals which react very rapidly and efficiently at this temperature. It then flows down to the bottom and upward through a suspended sludge blanket of precipitated solids which effectively reduces silica and filters out the bulk of the turbidity. Combination softeners with built-in condensate heater and storage compartment and/or steam scrubber (deaerator) are also available.



The effluent is filtered to remove last traces of suspended matter. Where zero hardness is required, Hot Process Softeners may be followed by a zeolite softener.

• • • •

For detailed information on these or any other types of water conditioning equipment, write: The Permutit Company, Dept. PE-9, 330 West 42nd St., New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

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